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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

Annual Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, December 1, 1893.

The Nineteenth Annual Meeting of the Society will be held in the city of New York, at the works of the Consolidated Gas Company, 18th street station, on Thursday, December 14th, at 3 o'clock, P.M.

FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

THE PROPOSITION TO PUT COAL ON THE FREE LIST.—As was to be expected the provision in the measure known as the Wilson tariff schedule to put coal on the free list has aroused some discussion, and more opposition, than would appear from the talks indulged in so far by the colliery proprietors of the country. The feeling in opposition is none the less positive, in that it is not voluble; for we imagine the mine owners and carrying agents are more bent on organizing for the defeat of the measure than in preparing set and sonorous speeches for public delivery expressing their discontent at the Wilson policy. One President of an American colliery, however, whose name is a household word amongst the gas managers, has given public expression in vigorous way to his opinions in the matter of the probable effect on the Eastern market of the admission duty free of foreign coal. The gentleman referred to is Mr. E. H. McCullough, of the Westmoreland Coal Company, and his views in the premises will be found fully recorded in our current item columns. He goes at the question in his usual systematic way, and it cannot be gainsaid that he makes out a more than plausible showing in the instance of the effect that a remission of the duty of 75 cents per ton would have on the sale of Pennsylvania coal in the Boston and Eastern market as against the Cape Breton or Provincial coals, immense natural stores of which are available at points about equally as distant from Boston as are the Pennsylvania mines. There is this thing, however, to be considered, in making an estimate of the relative values of the Pennsylvania and Nova Scotia coals as steam raisers, leaving out of the question entirely the cost in dollars per ton of each class of coals. No matter what the actual cost per ton to the user may be, the ordinary steam coals of Pennsylvania have a calorific value that is fully 20 per cent. on the average in excess of the calorific value of their Nova Scotia competitors. The latter are lean, sulphurous and uneven, and have been notoriously unsatisfactory to those who have tried them. Admitting this, though, does not soften the position that the Government may be acting unfairly in placing a poor foreign coal in the fair way to success in our market by permitting it to enter free and unrestricted. In any event, the remission of the duty will make little or no difference to miners and shippers of gas coal, since the standard gas coals of the States are so far superior to the Nova Scotia grades that the latter would almost be dear at any price.

THE PREPAYMENT GAS METER IN THE UNITED STATES.—For some time back the question has often been asked when, where and how the prepayment gas meter, which has met with a right good measure of success in England, was to be introduced in this country. In fact, the two

first questions taken from the question box at the last meeting of the American Gas Light Association were directed to this matter. The answers to the questions were vague and indefinite, nor could the replies very well be otherwise, since nothing of the kind had appeared in our markets. Still, at the very time the queries were propounded, something tangible in the way of a reply to them was coming into shape. The American Meter Company, whose officers during the past year or so had been considering the feasibility of introducing on this market an instrument of the prepayment type, reached the conclusion that the demand existed for such a meter. Accordingly the President of the Company, Mr. William N. Milsted, who is in every sense of the word a meter expert, was authorized to visit Europe for the purpose of going over the various types of prepayment meters on the foreign market, with a view to selecting one or more for manufacture and sale in the States. After an absence of several weeks, Mr. Milsted reports that the requisite selections were made, and it is now a settled fact that as soon as the necessary preparations are completed for the manufacture of the meters on a large scale, the American gas maker can try the prepayment scheme to his heart's content. It cannot be gainsaid that the prepayment plan has found great favor in England, where it is safe to say no less than 50,000 of the instruments—virtually all of which are of the 3-light description—are in use. In the South Metropolitan Company's district in London something like 20,000 prepayment meters are in position, and there are probably half as many in use in Liverpool. The meters, too, are gaining in favor on the other side, and there is great rivalry between inventors, who are far from convinced that the perfected instrument has yet been produced. Of course, it is rather early in the day to speculate on the degree of success which this ingenious instrument is to have in the United States, but we feel we are quite safe in saying that it will be regarded with popular favor in all of our large cities. We are, however, not so positive as to the welcome which will be accorded it by the clerical staffs of the gas companies, to say nothing of the index takers. Time will try and prove the whole thing, however; meanwhile the American Meter Company is to be congratulated on its enterprise.

THE SAN FRANCISCO GAS RATE.—For the past few months our news columns have contained pretty full reports of the movement inaugurated in the San Francisco Board of Supervisors for a reduction of the gas rate in that city, which movement had its inception in a popular cry during a local election, when some of the Supervisors were elected on a "platform," one plank of which pledged the candidates to "do all in their power to give cheaper gas to the citizens." We are pleased to be able to say that a majority of the Board have determined that the present rate ($2 per 1,000 cubic feet) is not excessive, and our pleasure in making this statement of the result is all the more intensified from the knowledge that the majority so decided only after a patient and thorough investigation of the subject. The attitude, too, held by the Gas Companies during the progress of the debate was nothing short of admirable. No temper was displayed, nor was ill-will charged to the investigators. The Companies, while denying the legal power of the Supervisors to alter or amend the rate in any manner (the gas interests held that such power was vested *only* in the State Legislature), nevertheless put no unnecessary obstacles in the way of the investigators. Their books and works were put at the committee's disposal, and an inspection of these, joined to temperate argument, was depended on to win the day. No attempt at concealment was made of anything that entered into the merits of the case, wherefore it may be accepted that the decision reached was a just one to the consumers and to the Companies.

NOTES.—We regret to report the death of Mr. Ira B. Copley, President of the Aurora (Ills.) Gas Light Company, whose demise occurred at his winter residence, No. 1118 Cedar street, San Diego, Cal., on the evening of November 24th. Mr. Copley had been in the habit of spending the winter season at San Diego for several years.——Mr. Charles A. Bennett, of the Freehold (N. J.) Gas Light Company, announces that on and after January 1, 1894, a reduction in the gas rate of 10 per cent. for prompt payment will be allowed. The current rates are: Illuminating gas, $2.60; fuel gas, $2.——The plant of the Elwood (Ind.) Electric Light Company was demolished by an explosion in the boiler room thereof on the evening of November 29th. Not only was the place put in darkness, but the surface cars, which were operated by currents supplied from the station, were completely "tied up."——The attention of gasholder constructors is called to the advertisement of the Altoona (Pa.) Gas Company, which is in the market for a triple lift holder of 1,000,000 cubic feet capacity.——The dividend of $2.50 per share recently declared by the Portland (Me.) Gas Company is payable on demand.——Messrs. Goodall & Perkins are developing an excellent bituminous coal mine on the tract of land recently purchased by them in the Coos Bay district. The coal is of excellent quality, and it is in great quantity, too.

[Prepared for the JOURNAL.]

The Holder Cup in Practice and in Theory.

By MR. WILLIAM E. MCKAY.

There is no gas valve so efficient as a water seal. If kept filled with water to sufficient depth, no leakage of gas will occur; and there are very many places where it is impossible to make use of any other means of making lines of contact absolutely tight. The water in the holder pit and in the holder cup effectively aids the easy variation of the stock of gas; but as every water seal is a danger line, so the multiplication of the holder cups, by the construction of three and of four lift holders, increases the necessity of care in the maintenance of the seals.

The original depth of the cup seal, as covered by the design of the constructors, is dependent upon the proposed pressure of the contained gas, with an ample allowance for the incidental or accidental loss of water from the cup when in actual use. Such losses will occur from evaporation, from leakage through the cup plates, from the careening of the holder, or from the withdrawal of the water by an accidental siphon. Holders with many cups are now built uncovered, and besides keeping the cup filled with water, it is important to prevent the formation of ice in the cup. In cold weather and in exposed locations occasional heavy falls of snow add to the difficulty of keeping the cups in good order, the snow shovelled from the crown of the holder lodging in the cups and chilling the relatively small quantity of water.

The two uncovered holders referred to in the following account are double lift, 150 feet in diameter, and are so placed as to be entirely without shelter from wind or storm in any direction, while exposed to temperatures varying from 100° above to 10° below zero. The depth of the cup is about 18 inches. The nearest point of the holders is about 400 feet distant from the boiler house; steam to the cups and pits is supplied through a main pipe 2½ inches in diameter, this pipe being underground, covered with asbestos and boxed without sawdust; this line is furnished with several sliding expansion joints. At the holders the 2½-inch pipe is divided into two 2-inch pipes, one running three-fourths way around each holder, still underground. Four 1-inch pipes, symmetrically distributed and suitably valved, furnish steam to the pit water, in each holder. Each cup is similarly supplied with steam through four ¾-inch pipes. The average temperature of the water in the cup, in winter, is not below 42° F.; in turning the steam on and off the following is the general observance:

A.—*With a falling thermometer.*

1. No wind, turn on when outside temperature is 28°.
2. With west wind, turn on at 30°.
3. With high north or west wind, turn on at 34°.

B.—*With a rising thermometer.*

4. With south or east wind, shut off steam when outside temperature is 28° to 30°.
5. With light west wind, shut off at 32°.
6. With high north or west wind, shut off at 34° to 36°.

When steam is on, the 2½-inch main pipe has full boiler pressure and full valve opening. The adjustment of the temperature of the cup water is controlled by the regulating valves at each small supply pipe. Under the worst conditions of weather and outside temperature, the foregoing arrangement has adequately provided for steam supply. A careful watch of the weather and the water during the winter seasons has been found abundantly to repay the expenditure for labor in the recognized economy of coal consumption.

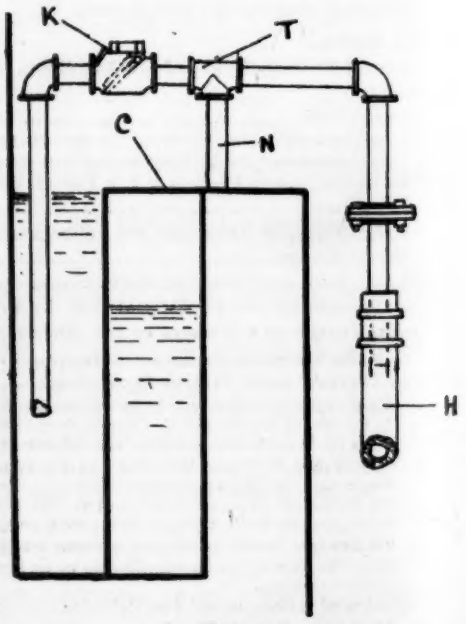


Fig. 1

The ¾-inch steam pipes for the holder cups are secured in the following way (Fig. 1):

A solid nipple N is tapped into the cover plate C, and furnishes support by the fitting T

to the ¾ inch pipe. A check valve (horizontal swinging) K is introduced, as shown, to prevent siphoning when the steam has been shut off. Connection is made with pliable rubber hose H, the other end of which is similarly fastened to the wrought iron pipe carried up an adjacent holder column to a height equal to half of one lift. Each piece of hose has length equal to ⅓ths the height of one lift or section of the holder, and the hose bends in an easy **U**, readily accommodating itself to the height or motion of the holder.

The cupping or uncupping of the holder varies the level of the water in the cup. Observation having furnished me with practical information of this variation of level, a comparison was made with the changes that should occur according to computation, and there resulted the following theory of the movements of gas and of water in the holder cup, at various points of the rise and fall of the holder.

1st. Suppose the holder cupped. The depth of the cup in question is 18 inches; a cross section would show the full width divided unequally into three parts by the several iron plates, somewhat as appears on the accompanying sketch (Fig. 2). The diameter of the upper section is 150 feet, pressure, 3.2 inches; diameter of lower section, 152 feet, pressure, 4.7 inches. Then, when the holder is cupped, and the pressure 4.7 inches, the volume of gas V_1 (see Fig. 2) per unit of circumferential length is $4 \times 4.7 = 18.8$, the cup being full of water, and the holder standing true—*i. e.*, not tilted by wind pressure nor by the guides. No account is taken of the space occupied by the iron division plates. The volume $V_2 = 18 \times 4 = 72$, and $v_1 = V_1 + V_2 = 90.8$. The volume of water W_1 per unit of circumference $= 13.3 \times 4 = 53.2$; $W_2 = 18 \times 2.8 = 50.4$; and $w_1 = W_1 + W_2 = 103.6$.

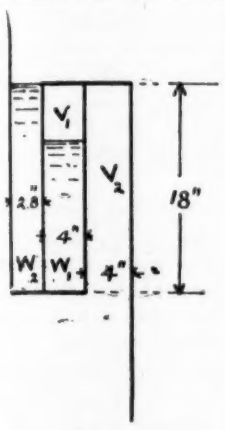


Fig. 2.

In the foregoing V_1 is the volume of gas between the two intermediate iron plates, V_2 is the volume of gas between the two outer iron plates; W_1 and W_2 are similarly contained.

2d. The holder is falling, and the lower section almost rests upon, but just clears, the landing stones, and the holder is ready to uncup. It is found that at this time (by observation) the difference of level between the water in the pit, when full, and the top of the cup plate of the lower section is 7 inches. As the holder falls the gases V_1 and V_2 are shut up in the cup as soon as the bottom plate of the cup strikes the surface of the water in the pit, and as the cup descends into the pit water these gases are compressed; but this increase of pressure is immediately relieved, in part, by an overflow of water from the cup. At the moment illustrated in the second sketch the holder is yet cupped, but is exactly at the point of beginning to uncup; the level of the water

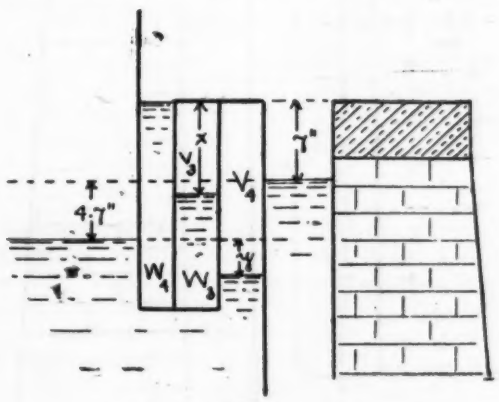


Fig. 3.

within the holder proper must be 4.7 inches lower than the level of the water outside the outer holder. Also (see Fig. 3) let x equal distance from top plate of cup to the surface of the water in the intermediate space, and let y equal difference of level of the water inside the upper section shell of the holder proper, and of the water in the outer space of the cup. Then x equals the new water pressure that would be shown upon a pressure gauge set upon the gas within the cup. V_3 and V_4 stand for volumes of gas in the same way as V_1 and V_2; W_3 and W_4 for volumes of water; of course the gases in V_3 and V_4 (similarly to the gas in V_1 and V_2) are under the same pressure, as the joint of the iron plate against the top of the cup cannot possibly be gas tight. Also, as the joint of the iron plate upon the inside bottom of the cup cannot be water tight, the water in W_3 and in W_4 is free to move in either direction, according to the variations of pressure. The ordinary atmospheric pressure of 30 inches on the mercurial barometer is equivalent to 408 inches water pressure. Let p_1 = pressure of the gas v_1 (see sketch under 1st), and let p_2 = pressure of the gas v_2, where $v_2 = V_3 + V_4$; then we have the following equations:

$y + 4.7 + 7 + x = v_2$, since $y + 4.7 + 7 = V_4$, and $x = V_3$.

$p_2 = x + 408$, and

$y = x - 4.7$, for the difference of level of the water under V_4 and of the water outside the gasholder must equal the excess of pressure of the gas v_2 over the atmospheric pressure. Also,

$v_1 p_1 = v_2 p_2$; $p_1 = 408 + 4.7 = 412.7$.

$v_1 = 18 + 4.7 = 22.7$, if the factor of width (=4) be disregarded, being the same in all the equations here considered.

Solving, $(2x + 7)(x + 408) = 9{,}368.29$.

$x^2 + 411.5\,x = 3{,}256$ (omitting tenths).

$x = 7.8$ inches.

Then $y = x - 4.7 = 3.1$ inches, and

$x = V_3 = 7.8$, and $V_4 = 14.8$.

$v_2 = V_3 + V_4 = 22.6$, while $v_1 = V_1 + V_2 = 18 + 4.7 = 22.7$.

By neglecting the factor of width (as above explained), the direct comparison of the volumes of the gases is greatly facilitated, and the algebraical computations are made more simple, while the final results remain unchanged.

$v_2 - v_1 = -.1$, and $p_2 - p_1 = 415.8 - 412.7 = 3.1$.

$3.1 \div 412.7 = .007512$, and $1 \div 227 = .004405$,

showing an apparent discrepancy in changes of volume and of pressure, but this discrepancy is not real, as it occurs in consequence of disregarding very small fractions of pressure.

Using the factors of width, we have:

$W_3 = 10.2 \times 4 = 40.8$; $W_3 + W_4 = w_2 = 91.2$

$W_4 = 18 \times 2.8 = W_2 = 50.4$; $w_1 - w_2 = 103.6 - 91.2 = 12.4 = q_1$,

showing that a quantity of water nearly equal to 12.4 cubic inches for every inch of the circumference of the cup must have overflowed from the cup into the pit. As, in the above calculations, the difference of diameter of the several shells of the holder has not been taken into consideration, then if we use the average diameter of 151 feet to compute the average circumference, the total quantity of the overflow is, in gallons,

$$Q_1 = \frac{151 \times 12 \times \pi \times 12.4}{231} = 305.6 \text{ gallons.}$$

In other words, as will be shown later, over 300 gallons of liquor of condensation could thus be forced from the cup into the outer pit every time that the holder uncupped.

3d. The next case considered is that when the lower section of the holder rests upon the landing stones, but the upper section has not fallen

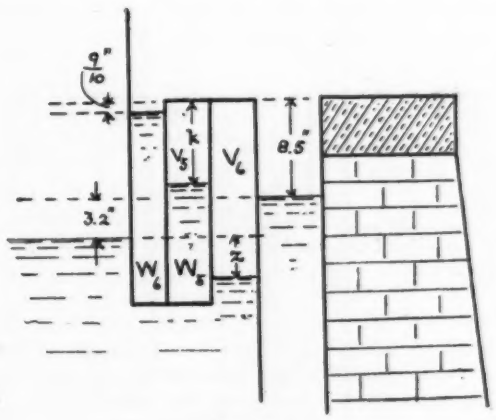


Fig. 4.

farther, so that no change whatever (from that described in case 2d) has occurred in the relative positions of the several parts of the holder shells.

The difference of level of the waters within and without the holder is now 3.2 inches, the so-called "pressure of the upper section." The area (A_1) of the surface of the water within the holder, is to the area (A_2) of the surface of the ring of water between the holder wall and the masonry, in the ratio $\frac{A_1}{A_2} = \frac{5625}{153} = \frac{37}{1}$; therefore, it is evident that this change of the difference of levels, from 4.7 inches to 3.2 inches, a change of 1.5 inches is accomplished by an apparent change of very nearly 1.5 inches in the level of the ring of water outside the holder. The sketch

(Fig. 4) shows the change described. It is effected by withdrawing gas from the holder so that the gas pressure falls from 4.7 inches to 3.2 inches, allowing the weight of the lower section to rest upon the bottom of the holder pit. The reduction in the volume of the gas contained in the holder is small, and in cubic inches is nearly equal to $\frac{1.5}{37} \times A_1$, where A_1 is expressed in square inches. The correct expression for this reduction in volume, in cubic feet, is $\frac{1.5 \times \pi \times 153}{12} = 60.08$. As the upper section of the holder, when full, has a capacity of 576,000 cubic feet, it appears that the change of $1\frac{1}{2}$ inches of pressure occurs with a change in volume of approximately $\frac{1}{100}$th of 1 per cent., or $\frac{1}{10000}$th of the total capacity of the section. The quantity of gas withdrawn, however, is different from 60.08, being equal to 578,160 — 576,000 = 2,160 cubic feet at 3.2 inches pressure, where

$$578{,}160 = \frac{412.7}{411.2} \times 576{,}000.$$

This gives an idea of the rate of change of pressure, or of the time of uncupping, when the rate at which gas is passing out of the holder is known. For instance, if 150,000 cubic feet per hour are leaving the holder, the whole time of uncupping takes less than a minute.

Referring now to the gas, $V_5 + V_6 = v_3$, confined within the holder cup, this is under new conditions. As the tension of the gas within the holder proper has decreased by 1.5 inches, the gas, v_3, is under a new pressure, p_3, 1.5 inches less than p_2. Then the difference of level of the water, W_5 and W_6 must be 1.5 inches less than before (W_3 and W_4) and equals 7.8 — 1.5 = 6.3 inches, and this change of level lowers the water in W_6 by .9 inch, raising it in W_5 by .6 inch, on account of the ratio of the several divisions of the cup.

$v_3p_3 = v_2p_2 = 9{,}368.3$; $p_3 = p_2 - 1.5 = 415.8 - 1.5 = 414.3$ inches, then $v_3 = 9{,}368.3 \div 414.3 = 22.6 +$ (showing no appreciable change in volume.)

But $V_5 = 7.2$ (since $k = x - .6 = 7.2$ inches); and $V_6 = v_3 - V_5$

$V_6 = 22.6 - 7.2 = 15.4$; then $z = 15.4 - (8.5 + 3.2) = 3.7$ inches, showing an increase of .6 inches over the difference of level y; this is as it should be, as the high tension of the gas in the cup drives the water lower in V_6 on account of the decrease in tension of the holder gas.

4th. As the holder continues to fall, and as that portion of the cup which is part of the upper section sinks into the pit water, the displacement of the pit water by the cup proper tends to produce a partial vacuum in the space occupied by the gas confined in the cup.

This decrease of the tension of the gas causes the water to rise in the section W_9, and also in W_7, and this motion of the water will continue until the water from W_9 begins to overflow into the section W_7; this is the moment illustrated in the sketch (Fig. 5.) At the instant referred to the difference of level of the water in W_7 and W_9 equals 3.2 inches,

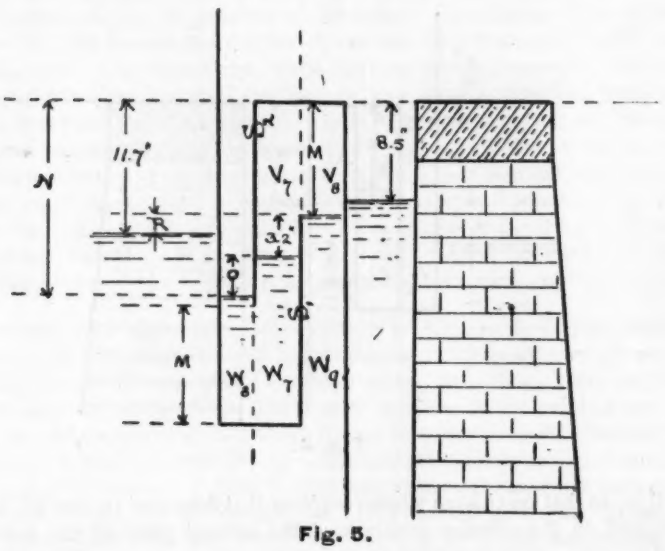


Fig. 5.

since W_8 is open to the atmosphere, and W_9 communicates with the water below the holder gas. It is also evident that O = in inches of water the vacuum that would be shown on a gauge set on the top of the holder cup. M denotes the vertical distance through which the upper section has moved since uncupping. Then p_4 = pressure of the cup gas = 408 — O. In the third case the water under V_6 was 15.4 inches from the top of the holder cup; in the fourth case W_9 has risen through (15.4 — M) inches.

It is also seen that the water under V_5 in the third case, has in the fourth case risen through (7.2 + O) inches. Now the cup in falling has displaced the water in the pit, and so created a volumetric displacement of (2.8 + 4) × M = 6.8 M; if this be divided by 4, to make the volume accord with the gas volumes, where the factor 4 was excluded, the displacement equals 1.7 M. The rising water in W_7 and W_9 moves to counteract, in part, this displacement, and hence we have $v_4 = V_7 + V_8 = v_3 + 1.7\ M - (15.4 - M) - (7.2 + O)$ (2) also, $p_4 = 408 - O$ (1); and $v_4p_4 = v_3p_3 = vp = 9{,}368.3$ (3), reducing (2) we have $v_4 = 22.6 + 1.7\ M - 15.4 + M - 7.2 - O$, but see fourth ease. v_4 also = 2 M + 3.2 (4), then 2 M + 3.2 = 2.7 M — O, whence $O - \frac{7}{10} M = -3.2$ (5) and $M = \frac{10}{7}(O + 3.2)$ (6); substituting in (4) we get $v_4 = \frac{20}{7}(O + 3.2) + 3.2$ (7); and substituting (7) and (1) in (3) (20 O + 64 + 22.4) (408 — O) = 7 × 9,368 3. Whence $O^2 + 403.68\ O = -1{,}516$, and O = 3.8 inches. Then M = 10; $v_4 = 23.2$; $V_7 = 13.2$; $V_8 = M = 10$; $p_4 = 404.2$, and R = 3.2 — (10 — 8.5) = 1.7 inches, and N = M + 3.2 + O = 17 inches. Showing that to an observer outside the holder, the water at W_8 apparently sinks or lowers to 17 inches below the top plate of the cup. If the plate S_1 leaks near the upper edge, or if a lateral displacement of the plate S_1 were to divide the space within the cup differently, so that V_7 and V_8 were in a different ratio, the water in W_8 would lower by an amount different from that above determined.

It is thus seen that while the upper section is descending through a vertical height of 10 inches, the water in the cup in W_8 is falling through 17 — .9 = 16.1 inches; if the holder were to remain stationary at a point just above the limiting 10-inch fall, pipes supplying steam to water in W_8 would require to be turned much lower than at any other time. The holder scarcely ever stands thus in practical working.

As soon as the water begins to flow from W_9 into W_7, its rate of flow increases until the maximum is reached and the force of the current is sufficient to carry some of the water below the edge of the plate S_2, and thus to force it into the division W_8. If condensed oil or drip liquor lies upon the surface of the holder water, it will be the first to overflow into W_7, and if the depth of such liquor lying within the holder is sufficient, it is clear that all of the liquid flowing from W_9 into W_7 could be this liquor. The flow described continues until the water at W_8 stands at the same level as the water between the holder wall and the masonry of the pit.

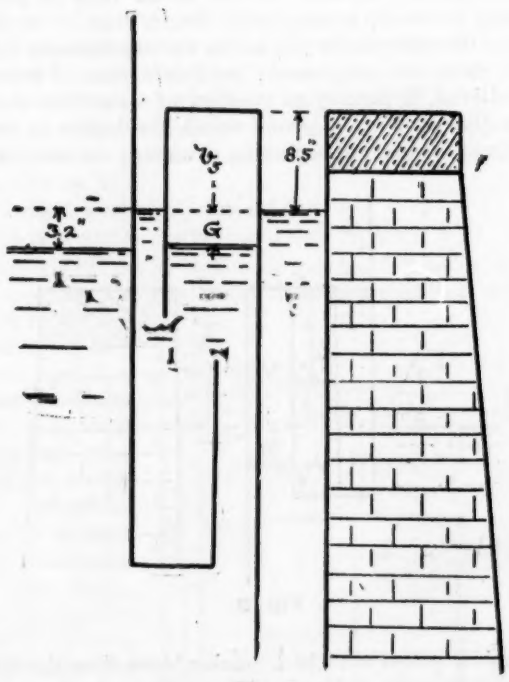


Fig. 6

5th. Suppose that equilibrium is again established, and the holder still falling. Let p_5 be the pressure of the gas within the cup; then $v_5 = 2\ (8.5 + G)$, and $p_5 = 408 + G$, $v_5p_5 = vp = (17 + 2G)\ (408 + G) = 9{,}368.3$. $G^2 + 416.5\ G = 1{,}216$, G = 3.0 inches. $v_5 = 2 \times 11.5 = 23\ 0$; $p_5 = 408 + 3 = 411$.

At this time the pipes supplying steam to the cup water must be turned down 8.5 inches lower than is necessary when the holder is cupped, and the cup evenly filled with water on all sides. If, then,

steam is turned on to the holder hose when the holders are cupped, as soon as they uncup the pipes must be turned down, or the steam, issuing into the atmosphere, will be useless and wasted; and when the holders cup the pipes must be turned up again, or else they are dipped into the water too much to permit the most effective use of the steam.

Frequently holder cups do not stand level. This may be due to construction, to adjustment of the guide wheels, or to effect of wind. Suppose, in the above holder, that the pipes were immersed 3 inches when the holder was uncupped, and that upon cupping, the holder canted, throwing the water out of level 6 inches, the steam pipes remaining undisturbed. A break in the hose could start a siphon, which, if it occurred on the high side of the holder cup, could draw the water from the cup as low as $8.5 + 3 + 6 = 17.5$ inches on the low side. Before this point would be reached in the process of siphoning, the cup seal would have been broken, and the upper section would literally fall through the lower section, and all the gas contained in the lower section would be lost, escaping into the atmosphere.

Such an accident could happen from other causes—as, when the holder is falling, if the lower section meets some obstruction in the pit, or the lowest guide wheels stick, the continued withdrawal of gas will break the seal, when the great weight of the lower section is no longer balanced by the pressure of contained gas, it generally suffices to break away or force through the obstruction, and both sections reach the pit water in the condition of just at the cupping point. In one instance an accident of this kind occurred when 300,000 cubic feet of gas was lost in three minutes. The cause was attributed to a piece of wooden staging adrift and afloat within the holder pit. The holder was not damaged in any way, however, and there was no possible way of definitely ascertaining the true cause of the break in the seal, as the cup was full of water, perfectly tight, and very nearly level.

6th. When the holder rises again the cup is filled with water, or with water and liquor of condensation in varying proportions. In the sketch (Fig. 7) the sheet S_1 is shown as on the point of rising clear of the pit

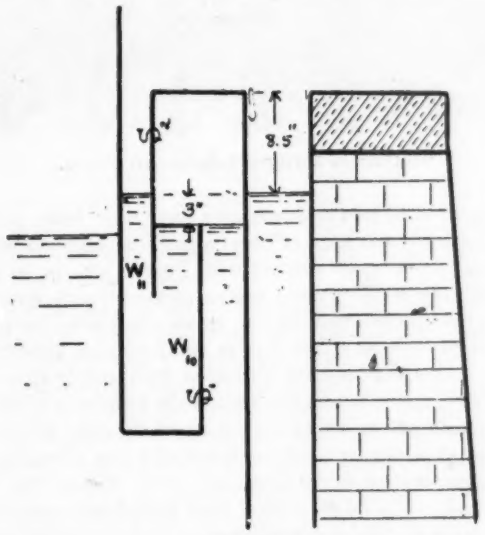


Fig. 7.

water; as the cup continues to move upward the gas confined within the cup forces the water, W_{10}, down on one side and up on the other side of the sheet S_2, finally causing the excess of water to overflow the cup into the pit. In the first case considered, the total water, w_1, carried in the cup was 103.6. In this case, the greatest amount of water carried in the cup (see Fig. 6) is $W_{10} + W_{11} = w_6 = 4 \times 18 + 2.8 (18 + 3) = 72 + 58.8 = 130.8$; and then $w_6 - w_1 = 130.8 - 103.6 = 27.2 = q_2$; showing that a quantity of water = 27.2 cubic inches for every inch of the circumference of the cup must overflow from the cup into the pit during the process of cupping. Denoting the total water thus overflowing from the cup by Q_2, we find that Q_2 in gallons = nearly $\frac{151 \times 12 \times \pi \times 27.2}{231} = 670.3$. If to this amount Q_1 be added, it appears that $(670.3 + 305.6) = 975.9$ gallons of liquid overflow from the cup into the outer pit every time that the holder cups and uncups. This furnishes the data for the depth of the superposed curb, in a holder cup fitted as shown in sketch (Fig. 8.) For each inch in depth that the water is forced from the section A, it rises in section B by $(4 \div 2.8 =) 1.43$ inches; then, by considering the greatest gas pressure that occurs within the cup, at any time of cupping or uncupping, the extreme height of the upper curb can be ascertained. If it is desired to prevent the overflow of any liquid from the cup, it will be necessary to add to the depth of the curb thus determined an allowance for the tilting of the holder, and the consequent unevenness of the plates of the cup. With the manufacture of enriched water gas it will often happen that some of the enricher oils will be condensed when the gas has been imperfectly fixed. If large quantities of such a gas pass into and out of a holder, a great deal of oil will accumulate within the holder, lying upon the surface of the holder water. Repeated cupping and uncupping of the holder may easily transfer considerable amounts of such liquor from within the holder to the belt of pit water outside the holder, whence it can run by the overflow. Here, therefore, is another danger developed, since the oil referred to is very inflammable, easily volatilized, and a great menace to any sewer or drain into which it may have run.

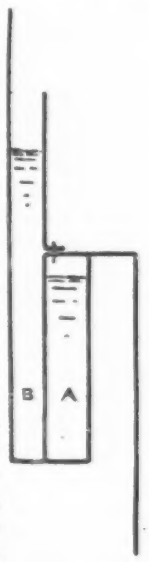


Fig. 8.

Suppose that the holder above described is cupped, and tilted to the extreme limit in one direction, so that the water on, say, the north side is low, 6 inches; the steam pipes being in service, and adjusted so that they dip by only 2 inches. If, now, the holder is tilted in the opposite direction, by reason of a change of direction of a very high wind, then a break in the steam hose on the north side of the holder could start a siphon which might lower the cup water 8 inches at that point; then the water at the south side, being already 6 inches low before the break, would be lowered to $6 + 8 = 14$ inches, and the seal would be broken. This fact makes necessary the re adjustment of the steam pipes after every extreme change of level of the cup water, following a change of direction of the wind, etc. The introduction of horizontal swinging check valves impedes the delivery of steam to the cup, but this objection can be offset by giving to the pipes such a capacity that there will be a surplus over the maximum requirements of the coldest weather; a primary object of the steam being to keep the water in circulation, the pipes should enter the water in such a direction that the impact of the steam may effect this object.

The general subject may be summarized by stating that frequent careful inspections would minimize the chances of an accident, the occurrence of which is easily possible.

On Apparatus for Promoting the Interaction of Gases.

[A paper read by Prof. George Lungé, Ph.D., of Zurich, before the World's Congress of Chemists.]

Both in theoretical and industrial chemistry one of the most frequent operations consists in the interaction between liquids and gases. On the laboratory scale this operation presents but few difficulties and is generally treated rather briefly, both in chemical literature and in laboratory teaching. Even here the matter is not quite so plain as is assumed by many chemists, and the success or failure of analytical operations is sometimes intimately connected with this question. Where the task is merely that of treating a liquid with a gas, irrespective of the quantity of the latter consumed, the question is certainly simple enough. But where it is required to completely absorb every trace of a special gas diluted with a large quantity of inert gases, the ordinary wash bottles and similar apparatus are mostly insufficient. I have made this matter a special study in connection with the estimation of nitric oxide in chamber-exit gases and similar difficult cases, and I have described the best shape of absorbing apparatus for such purposes in a communication to the *Zeitschrift fur Angewandte Chemie*, 1891, p. 567, and in the *Journal of the Society of Chemical Industry*, 1890, p. 1015.

The task becomes far more serious when operations on the large scale are concerned. The principal difficulties encountered here are the following: The immense volumes of gases which generally have to be dealt with and which sometimes contain but a small fraction of the gas or vapor which it is essential to bring into reaction with the liquid, and the necessity generally existing of employing the least possible quantity of liquid and of obtaining a strong solution, at the same time depriving the gases as completely as possible of the active constituent in question. Special difficulties arise in many cases through the corrosive action of either the gases, or the absorbing liquid, or both; from the fact of tar, soot, flue dust, and other matters obstructing the channels through which the gas and the liquid have to pass; through the pasty condition of some absorbing media, such as Weldon mud, and in other ways. A whole book might be written on the construction of absorbing apparatus for all these cases, and if all the patents taken out in this line were to be

noticed and illustrated therein such a book would be of formidable dimensions.

Certain points have always been taken for granted in devising apparatus of the class we are now speaking of. Everybody has tacitly assumed that the efficiency of such apparatus will be in proportion to the surface of contact and to the time which is given for the action. Dr. Hurter has attempted to give a scientific theory of that subject in several communications published in the *Journal of the Society of Chemical Industry*, 1885, 639; 1887, 707; 1893, 226. Unfortunately the various conditions to be taken into account are too complicated and partly too little known to be amenable to scientific treatment, and if such a treatment is attempted after all, it may sometims end in a decided failure and lead to entirely erroneous conclusions, as I have shown in my criticism of Dr. Hurter's last paper (the same journal, 1893, 417). I shall not detain you here with a repetition of that criticism, but I shall straightway come to that apparatus for effecting contact between gases and liquids which I have devised myself and which has been carried out by Mr. Rohrmann, my co-patentee, in a manner acknowledged on all sides (quite prominently so by Dr. Hurter himself) as being a hitherto unparalleled achievement in chemical pottery.

I believe I may assume that my apparatus, which I have styled "plate column" or "plate tower," is already known to many of my hearers both from my own publications and from the trouble my friend, Mr. H. J. Davis, has taken to bring it before the American public. It is also described in the second edition of my "Sulphuric Acid and Alkali," at least so far as it is used in the manufacture of sulphuric acid, and I must refer to this for a detailed treatment of the subject. I will, therefore, only say a few words about it and illustrate these by a diagram and by a small specimen of the plates.

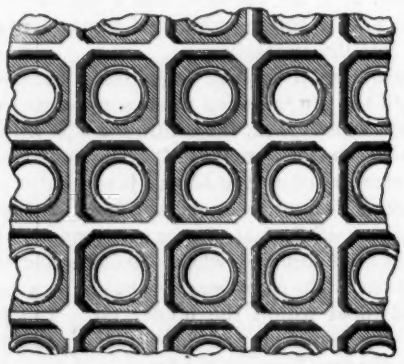
In order to adapt my apparatus to every kind of chemicals, the apparatus is made of a description of stone ware, absolutely resisting any chemical action of the strongest acids or alkaline liquids at temperatures far above 100° C., being at the same time very little sensitive to sudden changes of temperature up to the same limit. From this material my "plates" are manufactured on the following plan: Each plate is covered with a network of ledges, about an eighth to a twelfth of an inch high, forming square basins of three-fourths of an inch square each, or less than that, according to the size of the holes, so that a plate of 2 by 2 feet contains from 800 to 1,200 of such tiny basins. Each of these is provided with a central hole differing in width from less than a quarter to half an inch, according to circumstances. The top of each hole is surrounded by a slightly raised margin about a sixteenth of an inch deep.

The plates are made on two different patterns, in one of which the basins are distant from the edge by half the width of a basin, whilst in the other pattern they come right up to the edge. Consequently when these two patterns of plates are superposed over one another, the holes in each plate correspond to the center of the cross formed by the ledges of the four basins just above and below. Hence, when a liquid is run upon the plates each of the tiny basins is filled independently up to the edge of the margins round the holes. It then overflows through the hole, and the drop thus formed falls upon the cross of ledges underneath, and is scattered over the four corresponding basins. Furrows on the bottom sides of the plates prevent the drops from running along the bottom and falling down in other places than those where they are intended to get to. While in this manner the liquid is spread on each plate in a thin film, which is constantly renewed by drops from above in the most regular manner, the gases are just as regularly divided, and issue in about 1,000 jets through each plate without the possibility of any false channels being formed, which so frequently occur in coke towers.

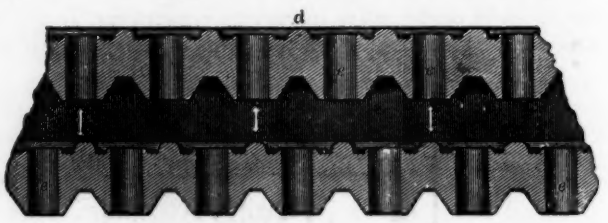
As the gas jets ascend through the holes in any one of the plates, they strike against the solid portions of the plate next above, and are thus deflected from their course and constantly mixed over again. All this will be more completely understood by looking at the diagram.

It is easy to see that ordinary pottery, even of the best known makes, will not stand in this case. The plates must be very thin and at the same time they must be absolutely level and true in all parts. They must also bear a certain mechanical strain and sudden changes of temperature, together with complete resistance to the action of chemicals. I did not know of any chemical pottery in Europe which fulfilled these conditions as well as that of Mr. Rohrmann, and for that reason I associated myself with him in that matter. I am glad to say that the large specimens of his plates submitted to the London and Liverpool meetings of the Society of Chemical Industry, by buyers of the same, have excited universal admiration there.

Where no metal, not even lead, can be tolerated, the plates are made of circular shape and are built up with stoneware rings to keep them in proper distance, in stoneware pipes, thus forming columns of circular section and containing up to 40 plates or even more. The sectional area of these columns is limited by the practicable width of the stoneware pipes and does not generally exceed 2 feet 6 inches. Large streams of gases, for which such a section would not suffice, have to be subdivided among two or more columns. Where, however, lead is not excluded, the plates are made square, and are combined by means of specially designed bearers in such a manner that any sectional area can be produced, the whole being inclosed in a leaden shell. The bearers support each plate independently of the others, and cover the whole of the lead so as to protect it entirely against the action of the heat and even of the chemicals, so that this system might be employed even in such cases where unprotected lead could not be employed.



Plan of Lunge-Rohrmann Plate.



Section of Lunge-Rohrmann Plate.

Plate towers of these two constructions have now been proved to be, size for size, probably the most efficient apparatus hitherto invented for bringing gases into intimate contact with liquids, except in such cases where there is some solid or tarry matter present which would obstruct the holes and fill up the small basins. In all other cases the plate towers are from 10 to 20 times as efficient as an equal space of the best arranged coke towers; and when they are compared with empty spaces, such as vitriol chambers, their efficiency is found to be hundreds of times greater than that of those spaces. From the nature of the case, plate towers can not be made of cheap materials turned out at a low price, but they are after all far cheaper than other apparatus with which they enter into competition, and would be so, even if their initial cost were equal to that of the coke towers or vitriol chambers they replace, seeing that they require next to no space, foundations and buildings, and that there is no pumping of liquids to a great height.

I now beg permission to illustrate my assertions by a number of examples taken from practical cases. I shall not touch upon some applications which may ultimately become very important indeed, such as the manufacture of acetic acid, but I shall confine my remarks exclusively to the application of plate towers in the manufacture of the so-called heavy chemicals, that is, sulphuric, hydrochloric, nitric acid, and chlorine.

The application of the plate towers in the manufacture of sulphuric acid takes place in three different ways, as a partial substitute for the Glover towers, as a partial or entire equivalent of the Gay Lussac tower, and as a partial substitute for the vitriol chambers themselves, enabling a set of chambers to produce up to 60 or 70 per cent. more acid than without the plate towers. I shall quote practical instances for all three applications.

As far as the Glover tower is concerned, it stands to reason that it can not be entirely replaced by a plate column, and that for two reasons. In the first instance, the quantity of dust carried over from the pyrites, or even sulphur burners, is so great that the plates at the bottom of the tower would soon be choked up. Secondly, the temperature of the gases entering at the bottom and that of the acid descending in the tower is

too different to expect any kind of pottery to stand the inevitable sudden changes and inequalities, at least in ordinary cases. Where, however, both these objections are done away with by a previous utilization of the burner gases for concentrating acid in lead or platinum dishes, as in Henry Glover's plan ("Sulphuric Acid and Alkali," second edition, 1, p. 201), the whole Glover tower might be made of a plate column. In the ordinary towers, however, the bottom part will have to be packed in the usual way with a network of bricks, or flints, or cylinders, while the upper part is filled with my plates. Or else the same plan may be adopted which has been applied with full success by Dr. Petri at the Buchsweiler works in Alsace. There they burn spent gas oxide containing, besides free sulphur, some ammonia salts, part of which is not removed by washing and exerts a destructive influence in the niter in the Glover tower. This well known reaction by which the nitrogen of both the ammonia and the nitrous vitriol is set free as such, takes place only at high temperatures. Reasoning from this, Dr. Petri put on the top of his ordinary Glover tower a small plate column, consisting of 13 layers of two plates each. The gases issuing from the Glover tower enter this small column at a temperature of 90° and leave it at 60° C., while the fresh nitrous vitriol is run in at the top and runs away at the bottom in order to feed the Glover tower. In this small column, holding altogether 40 cubic feet, 80 per cent. of the denitration takes place, for which an ordinary Glover tower of 8 by 8 by 25 feet, equal to 1,600 cubic feet, is generally provided, leaving only 20 per cent. of the denitration to the Glover tower and effecting the denitration at such a low temperature that the ammonia exercises no injurious action. The contrast between the efficiency of those 40 cubic feet of plate tower and the 1,600 cubic feet of ordinary Glover tower space is certainly startling. If, by the way, some of the plates should crack, they would all the same remain in their places and perform their work nearly as well as before.

The action of the plate column as a Gay Lussac tower is illustrated by an American works where a set of chambers of 212,000 cubic feet is provided with a plate tower of 20 layers of 10 plates each. This tower, possessing about 280 cubic feet of active space, now fulfills the function of a coke tower of about 4,000 cubic feet. But it is evidently too wide for its present work, and hence requires too much acid for feeding it equally all over. It is hence intended to pass the gases from another set of 123,000 cubic feet through it, and it is expected that it will be equal to this as well, in which case it would act like about 7,000 cubic feet of ordinary coke tower space, that is, 25 times its cubic capacity.

A very important advantage of the plate tower over the ordinary coke tower is the chemical indifference of the former to all the gases concerned, whereas the coke, as I have repeatedly proved, acts as a reducing agent upon the nitrous compounds and causes a loss of niter, together with a gradual crumbling of the coke packing, while a plate tower last practically forever.

Another advantage of the plate column is its inconsiderable height, which not merely makes the pumping of the absorbing liquid much easier than with the ordinary coke tower, but in some cases admits of altogether dispensing with pumping. Thus, at the last mentioned works the nitrous vitriol runs from the bottom of the plate tower serving as a Gay Lussac tower upon the top of the Glover tower, the former being placed at a convenient height for that purpose. This would have been impossible if the Gay Lussac had been an ordinary 50 or 60 foot coke tower. The matter might have been arranged just as easily in the opposite way.

The most important and interesting application of the plate column in the manufacture of sulphuric acid is that for diminishing chamber space. Every theory of the lead chamber process, worthy of such a name, supposes a constant interaction of the gases and the liquid portions floating in the chamber atmosphere in the shape of mist. Before that action is completed in the ordinary lead chambers, the ingredients must remain a very long time in contact with each other, and must quite gradually cool down, principally owing to the fact that the particles of the mist are separated by comparatively wide spaces and the action of the water or dilute acid on the nitrososulphuric acid is thereby greatly retarded. This drawback had been more or less clearly recognized by many previous inventors, beginning with Gossage, and many endeavors had been made to overcome it. But all these had either completely failed or at least effected their purpose so incompletely that they had been given up again. Thus all proposals for employing coke within the chambers for improving the mixture of the gases have necessarily broken down in consequence of the chemical action of the coke referred to above. Mechanical aspiration of the gases and re injecting them into the chambers has also failed to improve matters to a great extent. Some little time ago the Thyss process attracted much attention. In this lead towers are interposed between the chambers, filled with lead sieves, but, as might have been foreseen, the lead sieves were soon stopped up by lead sulphate and quickly destroyed. The Delplace chamber is another attempt to produce a better mixture of the gases, but it cannot attain this end at all completely or much better than any lead chamber of the old type.

By adapting my plate column to this special end, I believe I have solved the problem more efficiently than any of my predecessors. I based my proposal on the fact, first securely established by myself, together with Dr. Naef, that the rate of formation of the acid within the first chamber of a set is very unequal. This was proved by very numerous observations and analyses, carried on at a Swiss works for several months, and afterwards confirmed at other places by a number of entirely independent observers. The curve of acid formation rises rapidly to a certain height, but about midways in a 100 foot chamber it flattens and turns nearly to the horizontal, so that the second half of the chamber performs very little work indeed. But as soon as the gases pass over into the second chamber the formation of sulphuric acid is suddenly revived, thus proving that the contact of the gases and vapors with the end wall of the chamber, and their compression in the connecting pipe, exerts a very favorable influence on their interaction. Most probably several conditions are at work here. The shock of the vapors against the solid surfaces, by which the sundry particles forming in their separation a fog or mist are brought together and are made to interact; further, the better mixture of the gases during their passage through the narrow connecting pipe, and lastly the cooling action of the end wall of the chamber, which cooling, according to the modern theories of the vitriol chamber process, is essential for the production of sulphuric acid from its components. Having thus, as I believed (and I think justly) recognized the causes of the favorable influence exerted by dividing the chamber space into several chambers, and of the revival of the reactions distinctly observable between the first and the second chamber, I proceeded to draw the consequence of these views, by immensely multiplying the conditions found to be conducive to the acid-forming process. For this purpose I interposed, like Thyss, a kind of tower between the first and second chamber; but in lieu of simple lead sieves, which produce only an incomplete mixture, and which, as noticed before, are doomed to rapid destruction, I filled my tower with the plates I had previously devised for other purposes, consisting of chemically inattackable material, and by their geometrical design solving in the completest possible manner the problem of thoroughly dividing the gaseous current, and intimately mixing up its ingredients, together with innumerable shocks against solid surfaces. Even then two conditions for a proper chamber process would be absent, viz., the supply of sufficient moisture, and the keeping down of the temperature below the optimum for the process; and these two conditions I supply simultaneously by feeding the towers with more or less dilute acid, whose evaporation yields both the water and the cooling action necessary for compelling the reaction to take the best possible course.

Theoretically there is no reason why such columns should not take the place of the lead chambers in their entirety. Long ago similar plans have been proposed, and quite recently a Mr. Barbier has again taken out a patent for a system in which sulphuric acid is made without any lead chambers, in towers filled with earthenware cylinders, and fed with acids of different strength. In principle Barbier's plan does not at all differ from others which have been tried 10 or 20 years ago, and have failed. Just that failure, I must confess, has discouraged me from proposing the entire abolition of the lead chambers to other people; but if I possessed a chemical factory of my own, I should certainly have tried that plan with my plate towers three years before Barbier took out his patent, which, of course, cannot be applied to that well known principle, but only to his special kind of towers. For the present, at any rate, I do not venture to go beyond proposing to cut off the chambers at that point where all observations have proved the reactions to decrease rapidly in intensity, say at a length of 50 feet, and to replace the remaining length of an ordinary chamber by a plate tower, repeating this arrangement with the second, and if needful, with the third chamber of a set.

Up to this time no chamber system has been fitted up according to the plan just described, but in all cases the plate towers have been put between the existing chambers of an ordinary set, where they certainly perform a great deal of work, but evidently much less than could be done with a more perfect arrangement. I have therefore the right to consider the results hitherto obtained as a minimum; and looked at in this light, they are extremely encouraging, as far as I have been able to ascertain them, in which aim I have been much hampered by the unwillingness of many manufacturers to supply information for the benefit of their competitors. Thus, for instance, the United Alkali Company, in England, has erected a plate tower, but I have not been able to ex-

tract any information as to the works at which that has been done, and for what purpose, let alone telling me anything about the results obtained therewith. In a few cases, fortunately, I have been favored with more information, and this I will now lay concisely before you.

At a Bohemian works, the first where this plan has been adopted, and where, consequently, the best conditions were not yet ascertained, the plate column has raised the quantity of pyrites burnt to an additional 30 per cent. Beyond this it is impossible to go in that place, as there is no more room in the kilns; but as the chamber following the plate column has no work whatever left to do, the acid making process having been completed in the column, the real increase of chamber capacity has been 70 per cent.

At a Dutch acid works there are two sets of chambers of exactly the same dimensions, namely, one chamber of 64,400 cubic feet, and another of 19,950 cubic feet following this. In one of the two sets a plate column of 96 plates in all has been placed between the two chambers, and this set, I am informed, can be worked as if it held 22,500 cubic feet more than the other, so that each of the 96 plates would correspond to a space of 234 cubic feet, that is, more than 200 times the room occupied by the tower itself.

At Valencia, in Spain, a plate column had been working for 18 months when I received the last news about it. That set was then burning 42 per cent. pyrites in excess of what it had burnt before it had been provided with the column, whilst the consumption of niter had diminished from 2.2 down to 1.7 parts to 100 of 52 per cent. pyrites, which signifies a saving of nearly 25 per cent. of the niter. The yield of acid is excellent, and could hardly be better in that hot climate, where the first chamber in summer has a temperature up to 88° C. In the plate column it comes down to 28° or 50° C., and the gases go into the Gay Lussac with 40° C.

Looking at the very imperfect way in which the plate towers have been hitherto adapted to old sets of chambers, it is fair to hope that much better results than even those which I have been able to report would be obtained if that principle were more thoroughly carried out. Even the present results show an immense superiority over Barbier's system, which, according to his own statement, requires $\frac{1}{15}$th of the present chamber space, whereas my columns do from 100 to 250 times as much work as the same cube of chamber space. The reason of this great superiority evidently lies in the scientific construction of my plates, compared with the haphazard packing of other systems.

Allow me now to say a few words on the employment of plate towers for the condensation of hydrochloric acid. The very first tower which I designed was tried for this purpose, and the experience gained in that trial was utilized for a thorough reconstruction of the system. Since that time several plate towers have been supplied for the same purpose, and a very large one has been delivered just before my leaving Europe; but all information on the subject has been withheld from me, so that I cannot communicate anything on that subject beyond what was observed at the first trial, mentioned above, with the very imperfect kind of columns first used, at the celebrated Grieshiem works, one of the most carefully managed alkali works in the world. According to the official report then furnished to me, the following results were obtained. Two superposed columns, of 60 cubic feet each, with a total plate surface of 56 feet (reckoning both top and bottom side of the plate) effected the condensation of 90 per cent. of the gases issuing from a salt cake pot, decomposing 14 hundred weight of salt every 4 hours. The trial was continued for 24 hours in succession; the acid obtained varied from 15 to 22, and it averaged 20° Baume at 15° C. In England the smallest condensing space for such a quantity of salt would have been a coke tower of 7 by 7 by 40 feet, holding about 200 cubic feet and possessing a coke surface of about 20,000 superficial feet. Compare that with my 60 cubic or 58 superficial feet which did 90 per cent of the work!

The coke tower certainly possesses one important advantage over its dwarf rival, the plate tower. The former holds a large stock of liquid, serving as a regulator for the unavoidable inequalities in the composition of the gases, whereas the latter possesses no such regulating stock. But this drawback can and ought to be counteracted by placing in front of the plate tower 10 or 15 stoneware receivers of the usual type, or a few large stone tanks, through which the acid condensed in the plate tower gradually flows onward, and issues from the last of the receivers at full strength; the gases are made to travel the opposite way—viz., first through the receivers and then through the plate tower. In this case the stock of acid contained in the receivers serves the same purpose as that contained in a coke tower.

Most of the 130 plate columns hitherto sold, serve for another purpose than those I have so far mentioned—viz., for the recovery of nitric acid from the lower oxides of nitrogen by means of contact with air and water. I believe there is a general agreement on the point that no other existing arrangement for that purpose comes up to mine. In 1889, when the jury of the International Exhibition at Paris listened to an explanation of the new methods for producing chlorine, based on the use of nitric acid, it was taken for granted on all sides that the problem of recovering nitric acid from nitrous fumes had been definitely solved by my apparatus. As far as the manufacture of commercial nitric acid is concerned, it is significant that both the rival inventors of new condensing systems for that acid, Mr. Guttmann and the Griesheim Company, much as they differ in every other way, employ the plate column at the end of their plant, for dealing with the nitrous vapors. In the just mentioned case only a few per cent. of the total acid pass through the column; but in all these cases where nitric acid is employed as an oxidizing agent, and where the lower nitrogen oxides, evolved in that process, had been formerly lost, or only quite incompletely recovered, the plate column now steps in as the coping stone of the edifice. Instances of this kind are the production of chlorine in any one of the processes doing this by the aid of nitric acid, with or without the intervention of manganese or other agents; the manufacture of arsenic acid from white arsenic, or of phthalic acid from naphthaline tetrachloride; the manufacture of iron mordant for dyeing purposes; that of blue copperas from metallic copper, and to many other cases to be enumerated here. Formerly, whenever the treatment of nitrous gases was at all attempted, this was done by a string of perhaps a hundred separate receivers, or by a coke tower, the latter being saddled with the great drawback already mentioned—viz., its reducing action, in a case where the very opposite action is called for. In the March number of the *Journal of the Society of Chemical Industry* Mr. Guttmann mentions the fact that at the works managed by him a small plate tower, 10 feet high, performed the work formerly done by a coke tower 48 feet high, but much better; for the former made acid of 40°, the coke tower only such of 30°, and the plate tower actually satisfied the requirements of the Government Inspector, concerning the complete condensation of the nitrous gases, better than any other known apparatus.

In conclusion, I beg to point out one more interesting use of plate columns. When gases have to be dried, by bringing them into contact with moderately concentrated sulphuric acid, which has generally been done by coke towers, the plate column is most evidently in its proper sphere, on account of its cleanliness, its chemical resistance to any attack, and the inconsiderable height to which the acid has to be pumped.

Many other uses of the plate column will no doubt suggest themselves to the industrial chemist; but I will bring my remarks to a close, and not detain you any longer with my invention.

Mayer's Improved Gasholder Tank.

On September 26th U. S. Letters Patent (No. 505,629) were granted to Mr. Frederick Mayer, of Baltimore, Md., for improvements in gasholder tanks. Using the words of the specification:

Figure 1 is a sectional elevation of a gasholder tank embodying the present invention, and Fig. 2 is a similar view of a tank illustrating the invention in a modified form. Fig. 3 is an enlarged detail of Fig. 1, and Fig. 4 a similar detail of Fig. 2. Figs. 5, 6 and 7 are details illustrating further modifications hereinafter described.

Referring to Figs. 1, 2, 3, 4 and 6 of the drawings, *A* represents the circular concrete bottom of the tank, and *B* a circular brick wall erected on the concrete bottom.

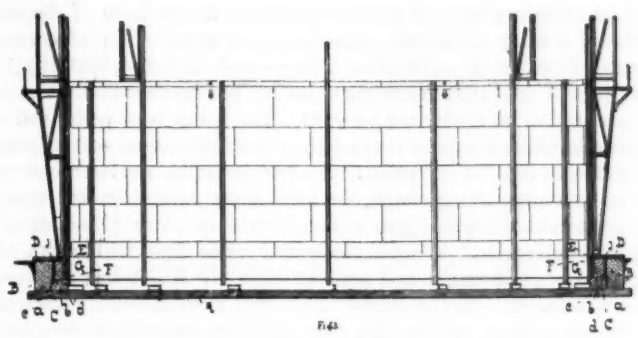
In Figs. 1 and 3 the brick wall *B* is only of sufficient height to effect a proper tight connection between the shell of the tank and the concrete bottom, as hereinafter described, while in Figs. 2, 4 and 6 the wall is much higher and constitutes, practically, one-half of the tank in height.

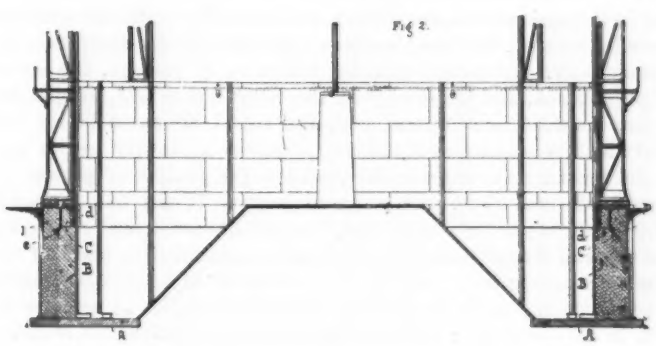
In Figs. 1 and 3, the wall *B* consists of two sections *a* and *b*, and over the latter is placed the metallic annular covering *C*, formed of the plates *c* and *d*, secured together by the angle iron ring *f*. The outside corner of the section *b* is flattened to produce the space *g* of angular cross section. The plate *d* and the upper flange of the angle iron ring have holes *h* which register one with the other, the said holes being placed, say 10 feet apart, and extending from these holes to the top of the wall *B* are pipes *j*, which, together with the wall, are covered with the coping *D*.

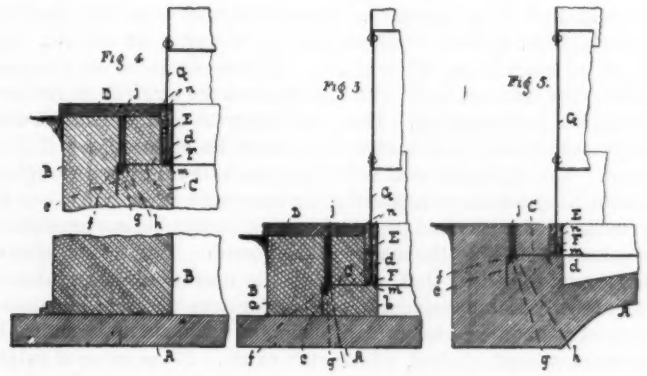
E is a recess or rabbet formed in the inner side of the section *a* of the wall *B*.

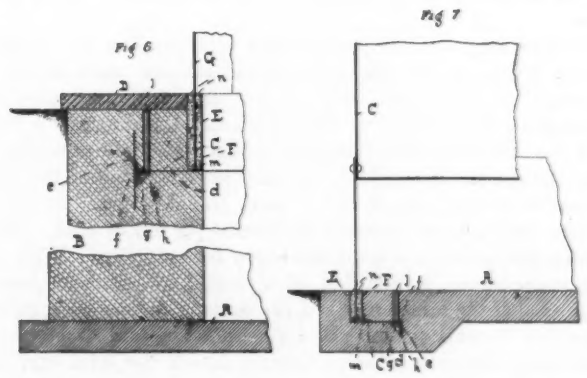
F is a plate iron cylinder secured by an angle iron ring *m* to the inner circumference of the plate *d* and extending from the bottom of the wall *B* to the top of the coping *D*.

G represents the plate iron shell of the tank, the lower rim of which









is seated on the angle iron ring *m*, which is situated at the bottom of the recess or rabbet.

In building the tank shown in Figs. 1 and 3, the concrete bottom *A* is first prepared. The section *b* of the wall *B* is next built, and the covering *C* having the cylinder *F* placed over it. The pipes *j* are then erected over the holes *h*, after which the section *a* of the wall *B* is built. The plate iron shell of the tank is now erected, and after its completion, or partial completion, cement grouting *n* is poured around both sides of the lower rim of the plate iron shell. Grouting is also poured into the pipes *j* so as to fill the space *g*, and also all vacant spaces below the plate *d*, and in order that the grouting may entirely fill the said spaces, temporary extension pipes are screwed on to the ones *j* to give a good head. The last step in the construction of the connection between the plate iron shell and the concrete bottom, consists in placing the coping *D* in place.

In building the tank shown in Figs. 2 and 4, in which the brick wall constitutes about one-half of the tank in height, the various steps described are practically the same, the only essential difference being that the wall *B* is not constructed in two distinct sections. The placing of the annular covering *C* is, however, about the same, the portion of the wall covered by it being, of course, constructed first.

In the tank, shown in Fig. 5, all brickwork is dispensed with, and the bottom and foundation for the plate iron shell formed entirely of concrete. The grouting is applied as before described.

In Fig. 6 the plate *c* is extended above the plate *d*. This construction is only necessary in tanks of large diameter and is for the purpose of resisting any expansion of the tank shell caused by atmospheric changes, by binding the entire brickwork surrounding the tank shell.

In Fig. 7 the top of the concrete bottom is level with the ground, and the plate *d* extends inward from the tank shell instead of outward.

Mr. Mayer's claims are:

I. In a tank for a gasholder, the combination of a plate shell, a concrete bottom, a brick wall erected on the said bottom, having a recess or rabbet on its inner face, an annular plate iron covering for a portion of the wall having an angular cross section, with an inner rim secured thereto, a plate iron shell, with its lower end seated in the recess or rabbet and resting on the horizontal annular plate of the plated iron covering, and suitable grouting situated between the said rim and the shell, and between the shell and the inner side of brick wall, substantially as specified.

2. In a tank for a gasholder the combination of a plate iron shell, the lower end of which rests on a horizontal plate inclosed partially in brickwork or concrete, a cylindrical plate situated at the outer periphery of the said horizontal plate, and a body of cement grouting situated at the junction of the two plates and under the same, whereby the joint between the said plates is made tight, substantially as specified.

3. In a plate metal tank for a gasholder, the means of connection between the bottom and the shell, consisting of a wall having a rabbet formed in the inner face of it, a horizontal plate built in the wall and forming the bottom of said rabbet, an inner rim attached to the inner edge of the said annular plate and a cylindrical plate attached to the outer periphery of the said plate, and at the junction of the cylindrical and horizontal plates and below them, a space extending around the entire shell, and pipes built in the brick wall and made to register with holes in the said horizontal plate, whereby grouting may be introduced into the annular space, substantially as specified.

4. In a tank for a gasholder, the combination of a concrete bottom, having thereon a wall with a rabbet in its inner surface, an annular plate extending from the inner face of the wall, a cylindrical plate extending downward from the outer edge of the annular plate with a grouting joint at the angle, pipes leading from holes in the annular plate to the top of the wall, and a plate iron shell seated in the rabbet and provided at both sides with grouting, whereby a water joint is effected, substantially as specified.

Gas Undertakings and the Price of Coal.

[Communicated by Mr. Norton H. Humphrys to the London *Journal*.]

For many years past the policy pursued by gas engineers and managers of gas works has been one of advance and retrenchment. They have worked with one end in view; and that has been "cheap gas." They have designed improved methods of dealing with the coal in the first place, in order to insure its distillation under the conditions most favorable for producing the largest possible quantity, and the highest quality of gas; and having generated this product, have followed it through the operations of condensation, washing, purification, storing and distribution, right up to the consumer's meter—searching carefully for economy or for improvement at every step. As indirectly helping to the same end, they have sought to improve the markets for their residuals, and have taken up the breaking of coke, the distillation of tar, and the manufacture of sulphate of ammonia. The primary object in view has not been the increase of profits. Outsiders who do not understand the working of gas undertakings might well suppose that the only goal was that of larger dividends for the shareholders. Some gas undertakings are only entitled to fixed rates of dividend, and therefore gain no direct benefit from these endeavors; while others, working under the sliding scale, obtain a direct advantage to a small extent, in being entitled to divide an additional unit per cent. of interest for every 8 cents reduction in price. But even under the regulations of the sliding scale, it has not been so much a question of increased profit as of popularizing the use of gas, finding fresh outlets for its consumption, and leading to the establishment of a large and steady trade, that would enhance the stability of the undertaking and the security of the capital invested.

If these ideas are anything beyond a chimera, and if the object that has claimed attention for so many years is a substantial one, and not merely a will-o'-th'-wisp, then it follows that the state of affairs prevail-

ing in the coal market, considered in connection with the events that have led up to it, is a terrible check that bodes ill for the future of the gas industry. The much-belauded reduction of leakage, the economy in purification, and the saving in the retort house are all like straws before the wind, as compared with the recent advances in the cost of coal; and the economies of the last quarter of a century are to go, not to the consumers or shareholders, but into the pockets of persons interested in the coal trade. I say this advisedly. If gas had remained at $1.25 or $1.50 per 1,000 cubic feet, the demand for it, and consequently the demand for gas coals would not have amounted to one-half of the present consumption. But for the existence of such a large demand it would be impossible to cut such discreditable antics as are now to be seen in the coal trade; and thus the exertions of gas engineers and managers have been so far perverted as to go to form a rod for their own backs.

We know very well the position that will be taken up by the sellers of coal, when confronted with considerations such as the above. "Please, sir, it wasn't me; it was the other boy," is an excuse that commences at an early period in our educational training, and is frequently found convenient in after life; and in this case, "the other boy" is the miners' delegate. During the last six years it is admitted that the miner has received an addition of 40 per cent. to his wages. At the outside, this does not represent so much as 50 cents per ton of coal. The wages agitation has formed a convenient bogey for extortion. With every increase to the miner, an addition of several fold has been made to the consumer. If the miner received 12½ cents, coal has been raised from 37½ cents to 75 cents per ton; and the increase said to be necessitated by the rise in wages approaches towards double the total sum disbursed under that item. It does not appear that the acceptance of a reduction in wages by the miner would be any guarantee for coal at a fair price.

A common fallacy is the idea that, after all, the price of coal is not a very important question in relation to the finances of gas companies, because a large proportion of it is recovered by the sale of residuals. This is quite a mistake; the only residual that is affected by the price of coal is coke. For every ton of coal carbonized, about half a ton of coke remains for sale; and it would be putting the case too favorably to say that the price of coke followed closely on that of coal. With coals at $4 per ton, coke will realize about $3; and with coals at $6, it will perhaps fetch as much as $4.50. In the first case it returns $1.50; in the second, $2.25. Out of the $2 extra for coal, therefore, only 75 cents is returned; and in actual practice, only about one-fourth of the increased price is recouped by the residuals. An increase of $1.50 per ton in the net cost of coal means an additional charge of about 16 cents per 1,000 cubic feet of gas, which is equivalent to a very large portion of the profits—in some cases, to the whole. This is sufficient to show that the importance of the price of coal, in relation to the prosperity of gas undertakings, has not been overstated.

The position of gas companies as consumers of coal has occupied a prominent place in the considerations of miners, labor agitators and those who are in a position to influence the selling price. The first article in the creed of such persons is the proverb, "One man's necessity is another man's opportunity;" and the facts that gas must be supplied to everybody who demands it, under penalties relating both to quality and to quantity, and that this cannot be done without a supply of the proper kind of coal, have led to the marking of gas undertakings as fair game for plunder. To sell gas coal cheaply is looked upon as a blunder worse than a crime. To buy coal cheaply is not much better; and the person who does so is regarded as deserving of no consideration. The gas companies must have the coal; and where the extra cost is to come from is a matter that is disposed of in a very loose way. Sometimes the convenient myth of exorbitant profits is trotted out, just as if the earnings could be depleted to the extent of 16 or 18 cents per 1,000 cubic feet of gas, and yet leave a remainder equal to a fair dividend. In the event of this source failing, it is hinted that the consumers should pay more for their gas.

The coal supplies for gas undertakings have always been independent purchases in the open market. They have made no attempt, either individually or in combination, to control prices; and the worst that has been done is the inviting of competing tenders. If at any time the coal has been secured at less than a fair price—that is, at a figure too low to admit of both a fair wage and a fair profit—the fault does not rest with the buyers, nor is the transaction of their seeking. But there must be a limit to this forcing of prices by sellers; and the events of the last few months tend to show that such limit is likely to be reached. Not only so, but coal owners and miners stand confessedly unable to devise any arrangement that will admit of a reliable and reasonable coal supply. If the question of price was not of moment, the irregularity in delivery, the holding back of promised supplies in the hope of disposing of them to greater advantage elsewhere, the repudiation of contract responsibilities while yet holding a large stock in hand, and the inferior qualities of coal that are being supplied, are matters that claim serious consideration on their own account. The losses now being suffered by gas undertakings extend beyond the actual additional cost of coal.

But what is a "fair" price? No one wants to see the miner ground down to a mere living wage, or the owner receiving less than a fair business rate of profit, equal to that earned in other branches of commercial enterprise. What is the lowest price that will admit of both reasonably good wages and profits? Sir G. Elliot has answered the question for us. In the course of his well-known consolidation scheme he mentions $1.97 per ton as a sum that complies with those conditions. No one has complained that this estimate is too low—indeed, some have thought that it is excessive. Then the question of the day, for gas undertakings, is this: If $2 per ton is a fair price at the pit, why are we called upon to pay $3 to $3.75? They are entitled to a square answer. The side issue, of who appropriates the extra 50 to 100 per cent. profit, is also interesting. The next thing to find out is whether this heavy tax on coal is a matter that must be endured, or if it can be cured. The aggregate coal bill of the gas undertakings throughout the United Kingdom must amount to an enormous sum; and when a large percentage of it is called in question, neither trouble nor expense should be spared in probing the matter to the bottom. Some time since there was reason to believe that, owing to the operations of speculators, gas companies did not receive a fair price for one of their residuals—sulphate of ammonia; and an Association of Sulphate of Ammonia Manufacturers was established, which still exists. If the price of sulphate is a matter worthy the attention of a society (and those who have read the reports issued a short time since must admit that the Sulphate Manufacturers' Association has justified its existence), surely there is room for some combined action in respect to this most important matter of our future coal supply.

Any combination formed with a view of beating down profits and wages below a fair and reasonable rate would be an iniquitous thing; but under the present circumstances of exorbitant prices and uncertain supply, combined action is not only perfectly justifiable, but urgently called for. Attention might first be directed to the possibilities of future supplies of coal on fair terms. If, on inquiry, it should turn out that there is no remedy for the present state of affairs, then investigation should be pushed in two directions. The first is the possibility of obtaining coal supplies from our colonies, or from foreign countries; and the second, the encouragement and development of means of dispensing with coal—such as those generally known as oil gas and water gas processes. Some of our Associations would do well to take the question in hand.

Looking at the magnitude of the interests involved, I have been surprised that this question has not excited more public attention amongst gas interests; but the silence may be accounted for in two ways. No one believed that the dispute would be maintained for so long a period, and we have all been looking, week by week, for a satisfactory settlement. Another reason is that many other industries are in much the same position as gas companies, of being compelled to hand over more than their total earnings for the aggrandizement of coal speculators. Some are able to cease working altogether, and thus avoid losing money; but that is a very dubious advantage. Possibly, therefore, the combination above hinted at might be extended to include all users of coal. The interference of legislative or other influence with private enterprise is only to be resorted to in extreme cases, and the state of the coal trade has already reached that stage. So it will be well for gas undertakings to see what can be done, before depleting their reserve funds or straining relations with their customers by raising the price of gas. Nor would such outside pressure be altogether a new thing, for surely the regular supply of coal at fair prices is a matter of as much importance in regard to the well-being of the public as gas or water supply, and many other things that now come under government regulation.

Carbon Dioxide as a Measure of the Efficiency of Ventilation.

By E. H. Richards.

From the time of Hippocrates, who gave as the sanitary maxim "pure air, pure water and pure soil," air has been placed first among the requirements of good sanitation. It is nevertheless a lamentable fact that, as Mr. Woodbridge has well expressed it, "the city which spends millions in water works for pure water supply and for sewerage for foul water removal, is still found tightening its purse strings when a few

thousands are asked for to provide for pure air supply to, and foul air discharge from its school rooms."

The reason of this apathy is not far to seek. Chemists and sanitarians have seriously disagreed among themselves as to what constituted "bad air."

People live and apparently thrive among the most nauseous odors, while under more favorable conditions they sicken and die. One theorist has given a reason only to be forced to the wall by another quite as plausible. Between them the advocate of pure air finds slight hearing. It is only within recent years that a knowledge of the significant fact that not to air itself nor even to the bad odors it carries, but to the dust particles bearing living germs and spores is to be attributed the spread of disease; therefore filtered air like filtered water has become a necessity where dust cannot be avoided by scrupulous care.

And now with our increased knowledge of the causes which lead to liability to disease, it seems probable that the chemist and sanitarian may at last unite in a winning fight for pure air. In a word, the new standpoint relates to the *resistance* which healthy blood and tissue present to the attacks of disease. This resistance is, we believe, due to the perfect nutrition of the blood corpuscles, and this is largely dependent on the inhalation of air containing sufficient oxygen.

In vitiated air the blood becomes quickly loaded with imperfectly oxidized products which cause derangement more or less serious and finally render the individual, who is poisoned from *within rather than from without*, more liable to succumb to disease.

If this view is in any measure correct it is important that chemists combine to urge upon the community the importance of a sufficient supply of air, especially in school rooms, and it is to be hoped that these views will command more respect than heretofore. It is notorious that even college halls and fine public buildings, which should be examples, are in fact the worst of any buildings.

The Laboratory of Sanitary Chemistry at the Massachusetts Institute of Technology has had, for the past nine years, exceptional opportunities for the study of the relation of the amount of carbon dioxide to the efficiency of the ventilation, in that the Walker Building is supplied with mechanical ventilation under the direction of an expert and in full control of the engineer, who has records for all these years of the amount and temperature of air supplied to each room, and of the temperature of these rooms taken four times each day.

During these nine years some 5,000 determinations of the amount of carbon dioxide have been made in these rooms by some 200 students.

Many problems have been studied and several reports published; without burdening this paper with details, to state a few of the conclusions reached may stimulate others to add to our meager knowledge on this subject.[1]

The outside air of the space around the Massachusetts Institute of Technology, Boston, varies from 3.7 to 4.2 parts carbon dioxide per 10,000.

The deterioration of the air as shown in the empty rooms is about 0.5 part, due to the decomposition of the organic matter present in the flues, the floors and in the walls.

The air of the building in general, halls and drawing rooms, reading rooms, etc., which are open and in which people are constantly moving, is maintained at about five parts as an average of examinations during eight years. In the ninth year there has been an increase due to an increased number of lecture rooms on the second floor.

The air of most of the lecture rooms has contained from six to eight parts; of the larger crowded halls for 200 or more students, ten to twelve parts according to weather, whether it is clear and dry and with a strong wind, or whether the air is loaded with moisture and is still.

From this experience it would seem that students can work well in a clean room with about seven parts per 10,000 of carbon dioxide; much more than this causes dullness, and anything over thirteen parts causes in most cases an almost impassable barrier to the full acquisition of knowledge.

When churches, halls and lecture rooms usually show from fourteen to eighteen parts per 10,000 in twenty minutes after the audience assembles, it is not strange that eloquence often fails to arouse enthusiasm.

1. Papers relating to the points discussed, contributed in whole or in part from the Laboratory of Sanitary Chemistry:

"On the Determination of Organic Matter in Air." Thesis, by Marion Talbot. *Technology Quarterly*, 1, 1887-8.

"The Number and Distribution of Micro-organisms in the Air of the Boston City Hospital with some Carbon Dioxide Determinations." By Greenleaf N. Tucker, in the twentieth annual report of the State Board of Health, of Massachusetts.

"A Critical Study of the Heating and Ventilation of the Walker Building, Massachusetts Institute of Technology." By S. H. Woodbridge. *Technology Quarterly*, 2, p. 76 and 192, 1888-9.

"The Determination of Carbon Dioxide in the Air of Buildings." By A. H. Gill. *Journal of Analytical and Applied Chemistry*, 6, 1892. This paper gives the method in detail which is used in the laboratory.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

It is said that Mr. Charles R. DeFreest, well known in democratic political circles of this State, will be appointed General Manager of the Troy (N. Y.) Gas and Electric Light Company, and the Troy City Railway Company, all of which properties are under the control of the Flower-Murphy-Brady syndicate. Mr. DeFreest has served as the Clerk of the Assembly for one or more terms, but the tidalwave, or hurricane, or blizzard of last November retired him, with several others, to the safer, if less profitable, haven of ordinary commercial life.

Mr. James M. Chisham, Superintendent of the Atchison (Kansas) Gas, Electric Light and Power Company, has been authorized by the proprietors of the Company to make the following announcement: "The Atchison Gas, Electric Light and Power Company announces the following rates for lighting, to take effect January 1, 1894: For gas in quantities of 10,000 cubic feet or more used by the consumer, $2 per 1,000 cubic feet, with a rebate of 25 per cent. if paid at the office of the Company by the 10th of the month in which bills are rendered. Quantities of 5,000 cubic feet and less than 10,000 cubic feet, $2 per 1,000, with a rebate of 12½ per cent. Less than 5,000 cubic feet, same rate as at present. Electric light: 16 candle power incandescent lamps, burning till 10:30 P.M., 75 cents per month, Company to furnish all wiring and lamps free. These rates are good for one year from January 1, 1894, and this Company will beat any rates offered by an opposition Company. Rates for all-night lighting will be quoted later. Persons desiring electric light or gas will be fitted up in the order in which application is made."

Mr. Irvin Butterworth, General Manager of the Columbus (O.) Gas Company, has prepared and distributed broadcast in that city a handsome single sheet handbill, prettily and appropriately illustrated, in which he calls attention to simple and sensible means of using gas. Perhaps a reproduction of the words of the handbill would best show how nicely he has told the story: "Now that the long winter evenings have come, when you should have good artificial light, we would esteem it a favor if you will notify us by telephone, mail or otherwise, of any matter pertaining to your gas lighting that may be unsatisfactory, out of order or needing attention even in the slightest particular. Upon receipt of such notice we will be glad to give the matter our immediate and careful attention. If any of your fixture keys work hard, let us know and we will put them in good order. If your burners are old we will furnish and put on new ones. If your burners are dirty and give out forked and irregular shaped jets, you can easily clean them by drawing the edge of a card through the slits; or notify us and we will send you a burner-cleaner made for the purpose. If your burners 'blow' or 'roar' at certain times, consult with us as to a remedy. If you want a good, clean, safe, convenient and economical light to read, write, sew or study by, get a suspending drop light or a portable gas lamp; they give a good, steady light right where you want it, and can, if desired, be decorated with silk or paper shades."

The Dauphin County (Pa.) Court has decided in effect that as gas works are manufactories the capital stock of such companies is exempt from taxation.

The notice of a motion for a temporary injunction, pending trial, to restrain the Rochester (N. Y.) Gas and Electric Company from using soft coal for steam-raising purposes, has been served. The plaintiffs are Messrs. Walters & Bebee, dentists, with offices in the Wilder Building, and their attorneys are Messrs. Hubbell & McGuire. Appended to the notice are the affidavits of D.W. Powers, Samuel Wilder, S. P. Moore, William Mudgett and others, declaring that the smoke from the Company's chimneys is an aggravated nuisance. Mr. Powers states that the soot from it gathers upon the pictures in his art gallery and in the drapery, resulting in serious damage. The proprietor of the Hayward Building, on South Clinton street, against whom proceedings had been begun, notified the attorneys in charge of the suit that he would discontinue the use of soft coal.

The Healdsburg (Cal.) Gas Company is putting in several thousand feet of 4-inch mains, which are to replace equal lengths of smaller mains. The works are also being enlarged and improved. The Company has adopted the plan of charging a nominal rental on stoves used for cooking and heating.

THE Board of Town Officers of Rye and Portchester, N.Y., have completed a contract for the public lighting of Portchester with the Consolidated Gas and Electric Light Company. The agreement provides that the Company will furnish gas lamps on an all-night schedule at the rate of $22.50 per lamp per year, the Company agreeing to submit to a penalty of double the charge per night on each lamp reported not on duty.

MR. EDMUND H. MCCULLOUGH, President of the Westmoreland Coal Company, was recently interviewed by a reporter of the Philadelphia *Public Ledger*, whose representative sought to obtain Mr. McCullough's views respecting the proposition in the Wilson tariff schedules to put coal on the free list. Mr. McCullough first handed the reporter the prospectus of a newly incorporated Canadian Coal Company, accompanying the presentation with a remark to the effect that he thought this concern would be greatly benefitted by the proposed change in the duty on coal. He then said: "The title of the incorporation is 'The Dominion Coal Company, Limited' Henry M. Whitney, of New York, a brother of William C. Whitney, is President, and John S. McLemon, of Montreal, is Treasurer. The prospectus, which, up to a short time ago, was widely circulated among investors in this country, is dated February, 1893, and states that the Company has been organized under the laws of Nova Scotia. It is proposed to issue stocks and bonds to the extent of $3,000,000, and to build at once a railroad from the Company's mines to Lewisburg, Cape Breton, a seaport 27 miles away. Now, American mines are much further away—from 300 to 450 miles away—from tidewater than this, and the expense of shipping coal is correspondingly greater. Ninety per cent. of the cost of American coal, you know, is paid for labor. The Cape Breton coal, the prospectus states, can be delivered on vessels at a possible cost of $1 per ton, probably cheaper than any coal that is shipped at any port in the world. Steam coals cost from $2.50 to $3 a ton, placed in the hold at the Atlantic seaboard. Distances and freights from Lewisburg, whence, by-the-way, would come the greater amount of foreign coal brought to this country, and from Philadelphia to Boston are the same, a freight of 75 cents being charged on each ton. If the tariff be removed on the foreign article the Canadian Company can offer their product there at $1.75, while American shippers must charge $3.75. With the present tariff of 75 cents per ton on the import, they have actually $1.25 advantage over us in the Boston market, and without tariff they would have $2 advantage. That the advantages of a free coal trade have not been overlooked by the projectors of the Dominion Coal Company is shown by this paragraph in the prospectus: 'Should the United States duty of 75 cents be removed, it seems evident that this Company will find a large market on the New England seaboard, for which its position at tidewater would enable it to compete in advantageous terms.' In the first year of importation, should the Lewisburg coal be admitted free, about 2,000,000 tons of American coal, it is claimed, could be displaced, and $7,000,000 taken from the pockets of American laborers. Another effect would be to slightly reduce the cost of coal east of Cape Cod, the difference flowing partly into the coffers of the Dominion of Canada in the way of royalties, the mines being leased from the Government, and partly into the pockets of Canadian laborers. If the serious disturbance in the price of coal in Boston takes place, it is fair to suppose that similar disturbances will occur at all points south of Cape Cod. The general effect of the loss of protection would be felt more severely by the producers of steam coal. The matter has aroused the protest of all the American coal shippers, and a clear understanding of the details of the case is of the greatest importance."

THE roof for the new purifier house of the Northern Liberties Gas Company, of Philadelphia, is now being put in place by the builders—the Berlin Iron Bridge Company, of East Berlin, Conn.

IN our last issue we intimated that the Safety Car Heating and Lighting Company, of New York, was about to establish a factory or factories for the manufacture of gas under the Pintsch system, at some point in Texas, and we now may add in referring thereto that one of these factories will be located at Houston, and a second one will be established either at Fort Worth or Dallas.

THE Town Council of Takoma Park, a beautiful suburban district of Washington, D. C., has passed an ordinance authorizing the Washington Gas Light Company to extend its pipes into and through the streets of the town.

A CORRESPONDENT at Salt Lake City, writing under date of November 24th, says: "The gas department of the Salt Lake and Ogden Gas and Electric Light Company is being greatly enlarged and improved. Main extensions are being carried out on Fourth West, between the gas works and Fourth South, and on Fourth South, between West Temple and State streets. In the first named stretch 12-inch mains are being laid, and 16-inch in the latter. Within the next six weeks consumers are promised a great improvement in the quality of gas by reason of improvements underway, under the immediate direction of Superintendent Kempf. The main improvement at the works is the substitution of regenerator furnaces for the old style direct firing type."

SAN FRANCISCO GAS LIGHT COMPANY,
SAN FRANCISCO, CAL., Nov. 29, 1893.

Dear JOURNAL: The enclosed complaint of a leak of gas at one of the shops in Chinatown, came to the office a short time ago. I know this quaint appeal for relief from the "bad gas breath" of our 23 candle product (which some of the descendants of John Alden and Priscilla consider inodorous) will touch the humorous vein in some of your readers. I am sure it will create sympathy for the pig-tailed Celestial who wears that far off look, thinks in Chinese, yet tries to write in English. No doubt it is a literal translation of one of the many idioms of their language, which are used to torture gas men in China. You will notice the poetical reference to a meter as a "gas watch."—Yours faithfully, E. C. JONES.

THE following is a reprint of the inclosure referred to by Mr. Jones, which is given as close as possible to the original:

Gas light company

My store gas watch had some a bad gas breath come out please you call gas maker come here to mend of them Your Gentlemen

Chong Jan Long Kee
1801 Dupont St
S F City

THE question of reducing the gas rate in San Francisco, which has been under consideration for some time by the Board of Supervisors of that city, was settled at a meeting of the Board, held on November 27th, in favor of the Company, which means that the selling rate shall remain, for the present at least, at $2 per 1,000. The Committee of the Board which had charge of the investigation submitted two reports, the majority favoring the adoption of an order reducing the rate to $1.90, while the minority asked that a rate of $1.75 be ordered; both reports naming January 1, 1894, as the period when the revised schedule should take effect. When the reports were read, Supervisor Forman said that he was one of the Board who had not been elected upon a pledge to reduce the gas rate, and thus far he had not been convinced that a reduction was necessary, or that it could be ordered in justice to the Gas Companies. The first proposition presented to the Board for adoption was the 5 per cent. reduction, and Supervisor Hinton opposed it because in his opinion the reduction was not sufficient. He argued that the reduction should be not less than 12½ per cent., which charge, he said, would still leave a profit ample to pay a reasonable dividend to the stockholders of the Gas Companies. In support of his position he quoted the price charged in Philadelphia ($1.50 per 1,000) and made a comparison of the cost of production in that city and San Francisco. He also referred to the time when the charges were much less, although labor and fuel cost double what they do at present. Supervisor Kennedy argued against any reduction, because he believed that the price was sufficiently low and that the competition of electricity would keep prices down to a just figure. Supervisor Denman supported Supervisor Hinton, stating that when he was elected he was pledged to see that the price of gas was reduced, and he wanted to do so. In his opinion $1.50 per 1,000 cubic feet was sufficient, but he was willing to compromise on $1.75. The proposition to reduce the price 5 per cent. was defeated by a vote of 9 to 3. The reduction of 12½ per cent. was also lost, the only members favoring the proposition being Messrs. Denman, Hinton and Stanton.

THE contract between the town of New Lots and the Union Gas Light Company, for the public lighting, which was taken over by the city of Brooklyn when New Lots was absorbed by the latter, expired last October. The price paid was $25 per lamp per annum, for every and all night lighting. The public lighting of the city at large for the ensuing year will soon be arranged for, and some curiosity is aroused as to the figure the Union Company will ask for the portion of the lighting that would naturally fall to it. The highest price paid to any other Company in the city last year was $22 per lamp.

THE following generous action by the Toledo (Ohio) Gas Light and Coke Company speaks for itself, the letter having been forwarded to President J. M. Brown, of the Associated Charities of Toledo: "*Dear Sir*—At a meeting of the Directors of the Toledo Gas Light and Coke

Company, held this day [December 4th], the following resolution was unanimously adopted :

"*Resolved*, That the Toledo Gas Light and Coke Company hereby donate to the Board of Associated Charities two thousand (2,000) bushels of coke. Said coke to be delivered on the written order of said Board of Charities to such persons and in such amounts as said Board may order. Sincerely yours, S. M. YOUNG, President."

"F. P.," WRITING from Toledo under date of December 5, 1893, says : "The Council last night rejected the proposition fixing the price of illuminating gas at 90 cents for a term of five years, and passed in place the old ordinance making the price $1 for the first five years and 95 cents for the next five. This is the 10-year contract which met with such disapproval when first proposed. The action of the Council was reached after some plain talk from Manager Faben, of the Toledo Gas Light and Coke Company. Mr. Faben said his Company could not predicate stock upon such a contract as was proposed. Mr. Coleman wanted to know why the Company could not make water gas, distribute it and collect the bills, for 45 cents, as was done elsewhere. Mr. Faben spoke of the enormous pipage here as one reason, and the limited consumption on account of electric light as another. Mr. Miller thought the Company should be given a fair show. Those voting 'aye' on the amendment to substitute the old ordinance were : Bender, Bussdicker, Dean, Hake, Harsch, Jacobson, Miller, Skinner, Steuer, Strohacker and Wheeler. Those voting 'no' were Coleman, Schmidt, Lee and Morris. Mr. Coleman then wanted an amendment ordering that the Company should furnish strictly coal gas, and Mr. Faben said he would object to that because it was not wanted by the consumers. It did not give as good light as the water gas did. He would give a mixture. Mr. Schmidt moved an amendment compelling the Company to obey section 3,561, Revised Statutes, which requires that the Company erect a photometer in the City Clerk's office which would prove the quality of the gas furnished the city. The amendment was adopted."

THE "Hayseed Gas Burner," according to the Baltimore *Sun*, is the name of an apparatus devised by Mr. Clarence M. Kemp, of that city. He says : "The harder you blow at this burner the more stubbornly does the light refuse to go out, and if by chance it is puffed out by very strong lungs, the gas is immediately relighted automatically. It is designed particularly for use in hotels where gentlemen of rural training retire for one night's rest and arise in eternity while the coroner holds an inquest on the remains."

THE Anderson Coke, Gas, Powder and Reduction Company has been incorporated in Chicago, by Messrs. James C. Anderson, Frank J. Smith and James B. Gascoigne. Capitalized in $10,000,000.

IN a general ordinance recently enacted in Philadelphia, concerning the paving of streets, it is provided that "before a permit shall be issued to any person, railway or other corporation to reopen a paved street, a sum equal to twice the cost of repairing an approximate number of square yards at $3 per yard shall be deposited with the City Treasurer, or ample security furnished for the restoration of the paving torn up." An amendment, reducing the fee from $4, which plumbers are required to pay for the privilege of opening a street, to $2, was also agreed to.

THE following is from the Rochester *Chronicle*, dated November 30 : "Justice Davy, in special term yesterday afternoon overruled the demurrer interposed on behalf of the defendants in the suit of Edwin Einstein, of New York, against the Rochester Gas and Electric Company and the Brush Electric Light Company, of this city, after hearing Edward Harris, of Harris & Harris, for the defendant, and Congressman John Van Voorhis and ex-Judge Danforth for the plaintiff. This suit was begun last July by Mr. Einstein to compel the Rochester Gas and Electric Company to issue to him 4,800 shares of its capital stock, or in default thereof to recover from the two defendant corporations the value of such stock which is placed at $480,000 by Mr. Einstein. The complaint in this action is a very voluminous document and it was printed almost in full in the *Democrat and Chronicle* on July 7th last. Mr. Einstein's case is based upon these facts : In 1881 Charles M. Rowley had acquired from the Brush Electric Company, of Cleveland, the right to use the Brush patents in Monroe county, and these rights Mr. Rowley sold to the Brush Electric Light Company, of this city, receiving therefor 48 per cent. of its capital stock of $100,000. It is alleged that the contract with Rowley provided that in case of an increase in the capital stock of the Company, 48 per cent. of such increase fully paid up was to be delivered to him or to his heirs or assigns. Shortly after this deal, Mr. Rowley assigned his stock and interest and claims to Mr. Einstein. In 1892 the various electric companies of this city were consolidated under the name of the Rochester Gas and Electric Company. Mr. Einstein claims that in carrying out the consolidation scheme the stock of the Brush Electric Company was increased to the extent of $1,000,000, and he claims that he is entitled to 48 per cent. of this increase in stock. Edward Harris made a long argument yesterday, in which he contended that there had been no increase in the capital stock of the Brush Company, and that each of the corporations maintains an independent corporate existence. At the close of the hearing Justice Davy said that he was pretty familiar with the facts in the case, and he believed he could dispose of it on the spot just as well as he could by taking the papers, reserving his decision and writing an opinion in the case. "I suppose an appeal will be taken from my decision no matter which way I decide." Counsel on both sides nodded in the affirmative, and the court said : "If I take the papers I cannot reach this case until late in January. The equities of the case are certainly with the plaintiff, and I think it is proper to give him the benefit of the doubt. I will, therefore, overrule the demurrer, and that will give the defendant time to appeal to the next general term."

THE Paris (Ky.) Electric Light Company has gone into the hands of a receiver, Mr. Alexander Washington having been appointed as such. Its liabilities in the shape of floating indebtedness are reported to be $10,000.

THE generating house of the Webster (Mass.) Gas and Electric Light Company is being enlarged.

Explosion of a Compressed Gas Cylinder.

Practical Engineer, in an article on this subject, says that a fatality which occurred recently in the streets of Bradford, England, brings rather prominently under notice an unsuspected source of danger to which the public are exposed from the extended use of compressed oxygen and hydrogen for magic lantern purposes, and to which it appears desirable to direct a little attention. As photographic amateurs will be aware, the gas for operating the oxy-hydrogen light is now supplied in a convenient form in weldless steel cylinders by companies who make a specialty of the manufacture. The gas is compressed in the cylinders to an exceedingly high pressure, 120 atmospheres, or nearly 1,800 lbs. per square inch, being about the usual limit. It will be evident that the rupture of a cylinder about 8 inches in diameter and 3 feet or 4 feet in length, under a pressure such as that just named, is not a matter to be trifled with, and that adequate security should, at least, be furnished in the shape of an ample margin of safety. We fear, however, that in this respect many of the cylinders now used are seriously deficient. It is customary, we believe, by those engaged in the trade, to test the cylinders up to a pressure of 1½ tons on the inch, and to load them, as we have stated above, to 120 atmospheres, the test pressure being thus rather less than twice the working load, the exact ratio being 1.8.

We believe it is not an unusual thing for the cylinders employed to show signs of distress, and be rejected in consequence, even at this low test pressure, while it will probably be a surprise to many to know that a pressure of 2 tons on the inch would cause deformation and bulging in a great many instances. Accepting this as practically the maximum limit of strength, it gives a factor of safety of about 2½. This, we have no hesitation in saying, is insufficient, especially considering the shocks and rough usage to which these vessels are occasionally liable. Their harmless appearance conveys no adequate idea of the enormous store of energy contained within. They are carried about the streets of crowded thoroughfares in charge of boys, who are apt to pitch them from their shoulders, or bring them down on the pavement with a bang, like a log of wood, with possible consequences that are fearful to contemplate. That the danger is not imaginary was fully illustrated by the fatality to which we have alluded at Bradford. A boy, about 14 years of age, was dispatched by a firm of lantern dealers, with a couple of these cylinders in his charge, to the station. The burden appears to have been somewhat beyond his powers, with the result that he was trailing one of these cylinders after him along the ground, when it suddenly exploded, without a moment's warning, and killed him on the spot, while a man who happened to be behind him was also injured.

We have ourselves frequently seen these charged cylinders handled by porters at railway stations in a way calculated to excite considerable misgiving, and we have wondered whether railway companies were aware of the dangerous character of these harmless-looking vessels, and of the risks which, through acts of carelessness or ignorance on the part of servants, attend their transit. Quite recently we observed them used as log rollers for moving a heavy load in a railway yard.

The Market for Gas Securities.

The feature of the week in the trading in local gas stocks was the decline in Consolidated, which opened to-day (Friday) at 130½ bid, offered at 131, which is a loss of 4 points from the quotation of a week ago. We know no reason for the weakness in the shares, which really ought to be in the ascending instead of in the descending scale. The Company's business is booming, and it is well equipped to meet every possible demand that can be made upon it. Mutual continues to harden and Equitable is in good demand, at increasing quotations. The Brooklyn situation is nothing if not perplexing, all descriptions of gas stocks there having made substantial gains, save in the instance of Citizens, which hangs lifeless, at 50 bid. Metropolitan sold at auction this week at 150½. It is true only 6 shares were disposed of, but we doubt if a bid of 150 would bring out much stock or in a round lot. Now that Mr. Addicks has settled up the Boston business, we may look for a pronounced movement by him in the Brooklyn proposed consolidation. Chicago Trust has declared a cash dividend of 1½ per cent. for the quarter, and strangely enough the stock sold off on the announcement. Baltimore Consolidated is stronger, and Bay State just about holds its own. At auction this week: 480, Peoples, Brooklyn, at 75; 80, Williamsburgh, Brooklyn, at 141.

Gas Stocks.

Quotations by Geo. W. Close, Broker and Dealer in Gas Stocks,

16 Wall St., New York City.

December 11.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	130½	131
Central	500,000	50	90	95
" Scrip	220,000	—	—	100
Equitable	4,000,000	100	190	195
" Bonds	1,000,000	—	106	108
Harlem, Bonds	170,000	—	—	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	145	150
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	80	95
" Bonds	150,000	—	—	100
Richmond Co., S. I.	346,000	50	50	65
" Bonds	20,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	—	32
Preferred	5,000,000	100	64	70
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	110	115
Citizens	1,200,000	20	55	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co.	2,000,000	100	—	—
Bonds	1,000,000	—	25	40
Fulton Municipal	3,000,000	100	130	135
" Bonds	300,000		103	—
Peoples	1,000,000	10	75	80
" Bonds (7's)	368,000	—	100	—
" " (6's)	94,000	—	98	100
Metropolitan	870,000	100	140	—
" Bonds (5's)	70,000	—	100	—
Nassau	1,000,000	25	145	—
" Otfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	135	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	16½	17
Income Bonds	2,000,000	1000	40	—
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	77	79
2d " " "	3,000,000	1000	—	57½
Buffalo Mutual, N. Y.	750,000	100	110	—
" Bonds	200,000	1000	95	100
Citizens, Newark	1,000,000	50	155	160
Chicago Gas Company.	25,000,000	100	66⅜	66½
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	81⅛	81½
Consumers Gas Light Co., Jersey City	2,000,000	100	—	30
Bonds	600,000	1000	—	85
Cincinnati G. & C. Co.	7,000,000	100	192	—
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			—	100
Capital, Sacramento, Cal			—	55
Consolidated, Balt	11,000,000	100	54	—
" Bonds	6,400,000		107	107½
Citizens Gas Lt. Co., Rochester, N. Y.	500,000	—	85	101
Bonds	250,000		—	—
Detroit Gas Co.—				
1st Mortgage			45	—
East River Gas Co., Long Island City	1,000,000	100	—	—
Bonds	500,000	100	86	87
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1000	—	101
Hartford, Conn	750,000	25	120	128
Jersey City	750,000	20	190	200
Louisville, Ky	2,570,000	50	125	130
Laclede Gas Light Co. St. Louis, Mo.—				
Common Stock	7,500,000	100	16½	17
Preferred "	2,500,000	100	68	70
Bonds	9,034,400	1000	84¼	84½

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by a young man of 20 years' experience in all details of the business—manufacturing, mechanical and clerical. Has made the stove business a specialty for the last 8 years. Best of references.

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Must be thoroughly conversant with coal gas machinery. State previous employers and experience. None but first-class need apply.

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Tar Product of 1894,

making gas under old process from best Westmoreland gas coal. 250 barrels will be about the amount of the product. Bids will be opened Jan. 1, 1894, at 2 P.M.

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ALTOONA, PA., Dec. 5, 1893.

Designs and bids will be received up to and including December 31st, 1893, for the erection of a

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The several sections to be 30 feet deep each, and of the following diameters: Outer section, 123 feet; second section, 121 feet; inner section, 119 feet.

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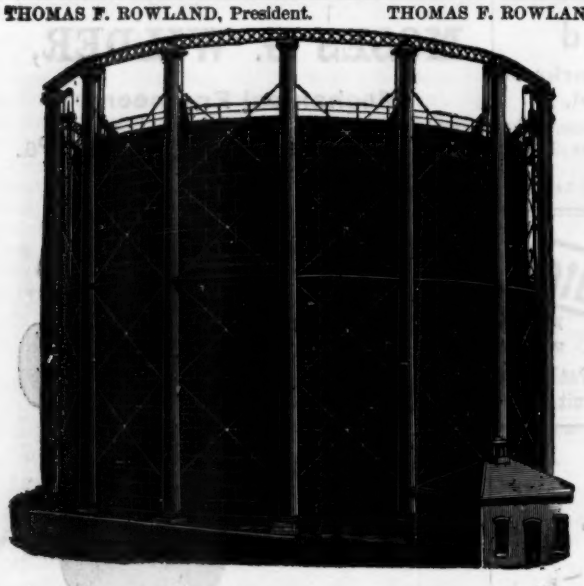

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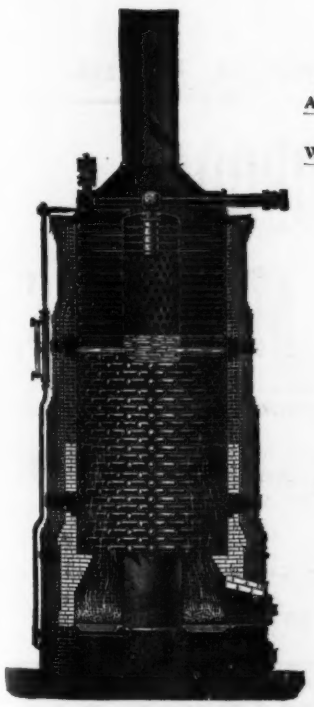

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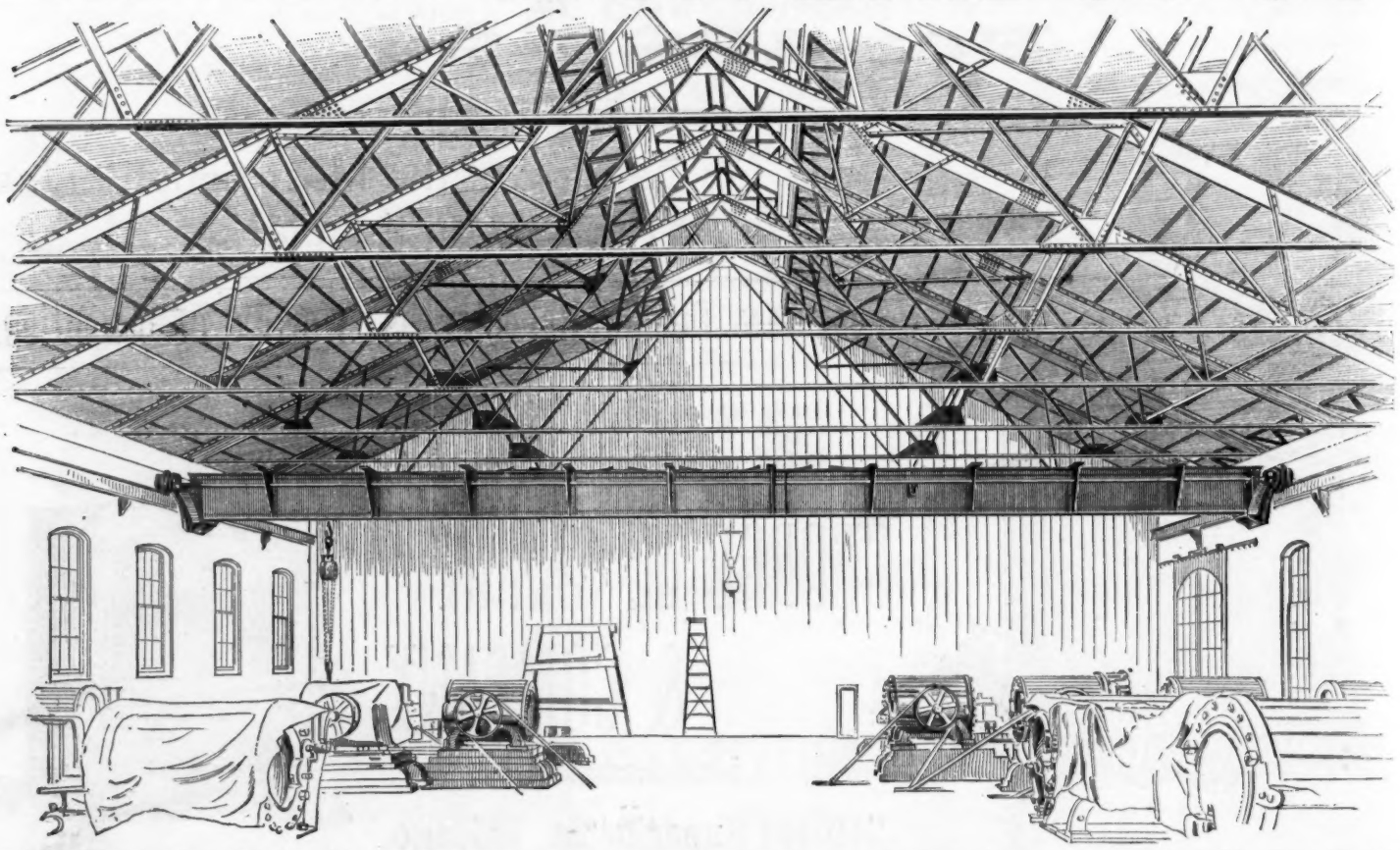

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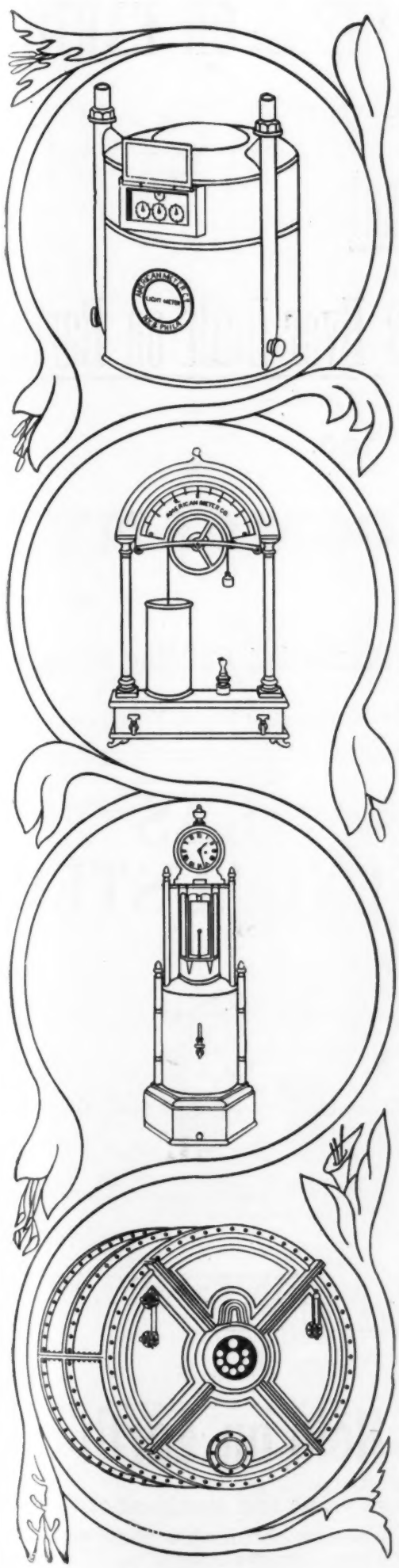

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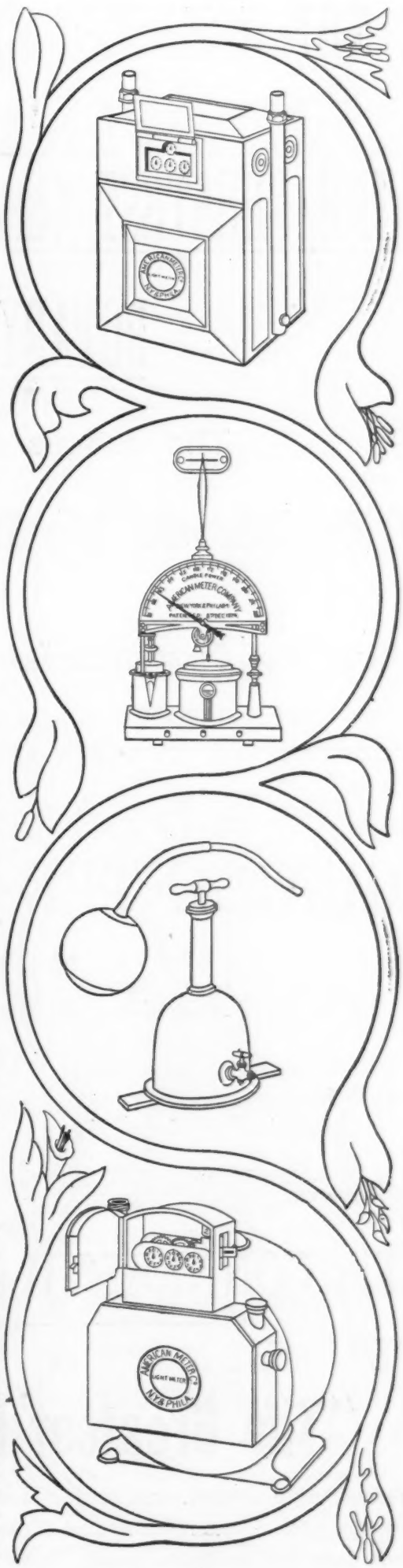
PUBLIC LIGHTING TABLE.

DECEMBER, 1893.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Fri.	1	5.00 PM	2.30 AM	4.20	6.10
Sat.	2	5.00	3.30	4.20	6.10
Sun.	3	5.00	4.30	4.20	6.15
Mon.	4	5.00	5.40	4.20	6.15
Tue.	5	5.00	6.10	4.20	6.15
Wed.	6	5.00	6.10	4.20	6.15
Thu.	7	5.00	6.10	4.20	6.15
Fri.	8	5.00 NM	6.10	4.20	6.15
Sat.	9	5.00	6.10	4.20	6.15
Sun.	10	5.00	6.10	4.20	6.20
Mon.	11	5.00	6.10	4.20	6.20
Tue.	12	5.00	6.10	4.20	6.20
Wed.	13	8.30	6.10	4.20	6.20
Thu.	14	9.30	6.10	4.20	6.20
Fri.	15	10.30	6.20	4.20	6.20
Sat.	16	11.30 FQ	6.20	4.20	6.20
Sun.	17	12.50 AM	6.20	4.20	6.20
Mon.	18	2.00	6.20	4.20	6.20
Tue.	19	3.20	6.20	4.20	6.20
Wed.	20	4.20	6.20	4.20	6.20
Thu.	21	No L	No L.	4.20	6.20
Fri.	22	No L FM	No L.	4.20	6.20
Sat.	23	No L	No L.	4.20	6.20
Sun.	24	5.10	7.20 PM	4.20	6.25
Mon.	25	5.10	8.40	4.20	6.25
Tue.	26	5.10	10.00	4.20	6.25
Wed.	27	5.10	11.10	4.20	6.25
Thu.	28	5.10	12.20 AM	4.20	6.25
Fri.	29	5.10 LQ	1.20	4.20	6.25
Sat.	30	5.10	2.30	4.20	6.25
Sun.	31	5.10	3.30	4.20	6.25

TOTAL HOURS LIGHTING DURING 1893.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January...	217.30	January...	423.20
February..	200.30	February..	355.25
March	177.50	March	355.35
April.....	160.30	April.....	298.50
May.....	149.00	May.....	264.50
June.....	140.30	June.....	234.25
July.....	143.40	July.....	243.45
August....	154.50	August....	280.25
September.	171.50	September.	321.15
October...	202.20	October....	374.30
November.	221.30	November.	401.40
December.	248.50	December.	433.45
Total..	2188.50	Total..	3987.45



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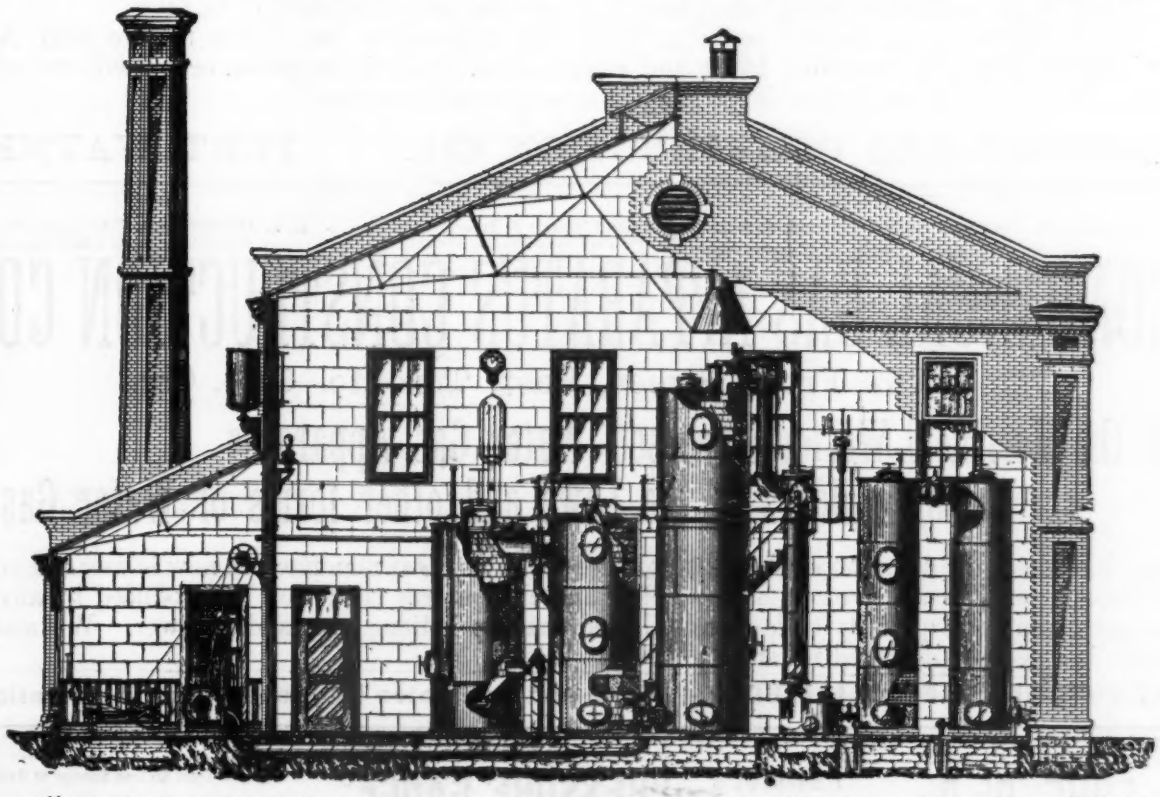

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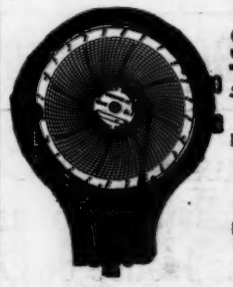

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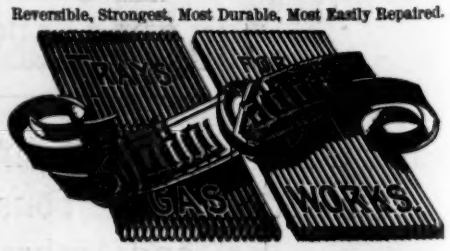

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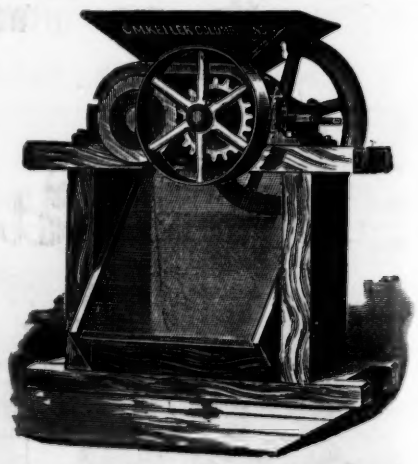

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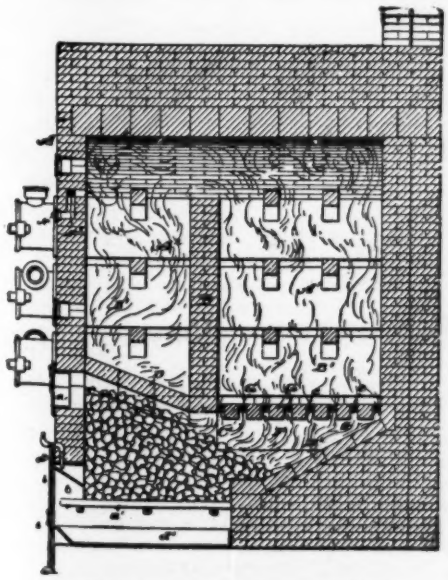

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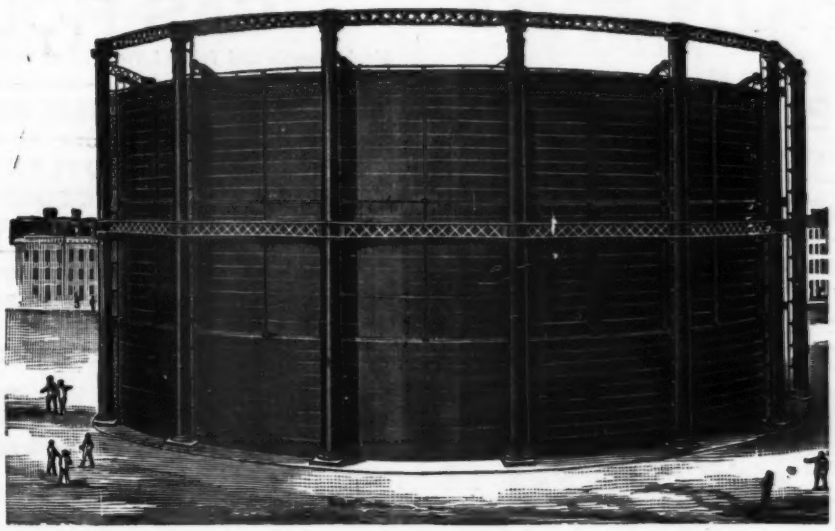

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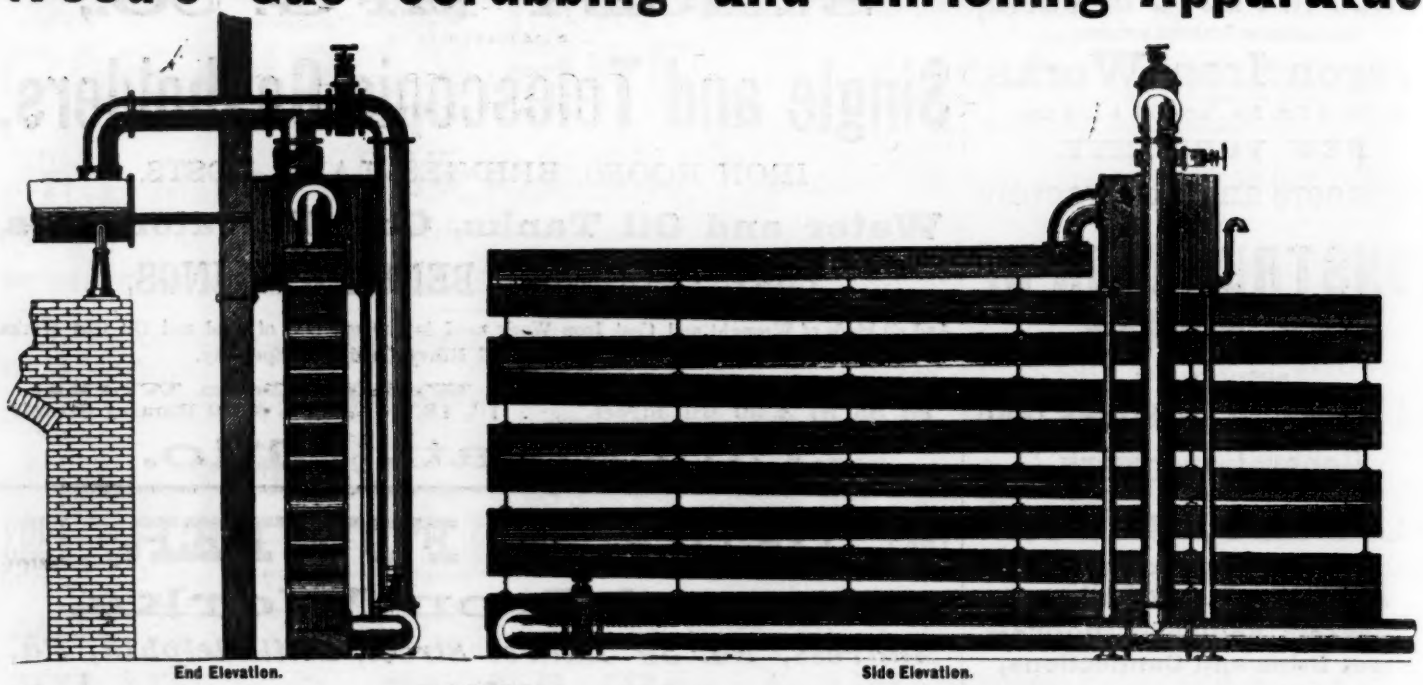

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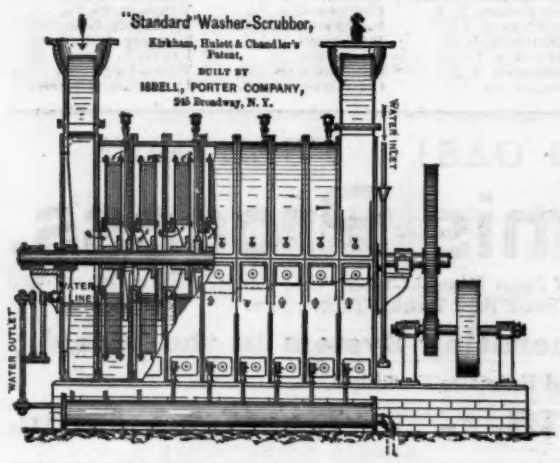

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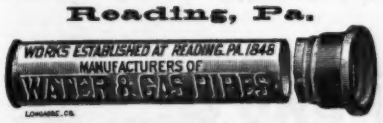

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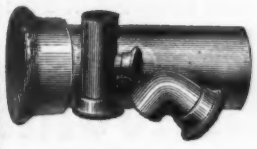

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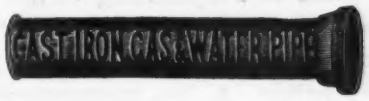

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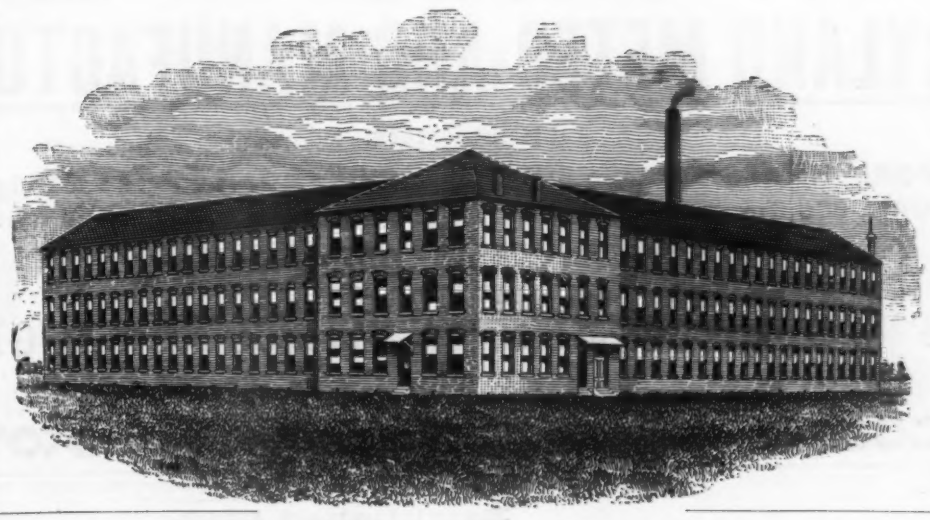

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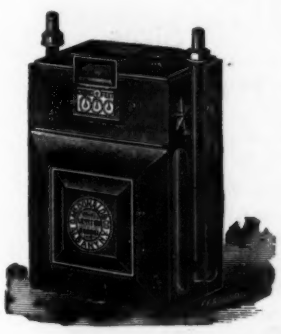

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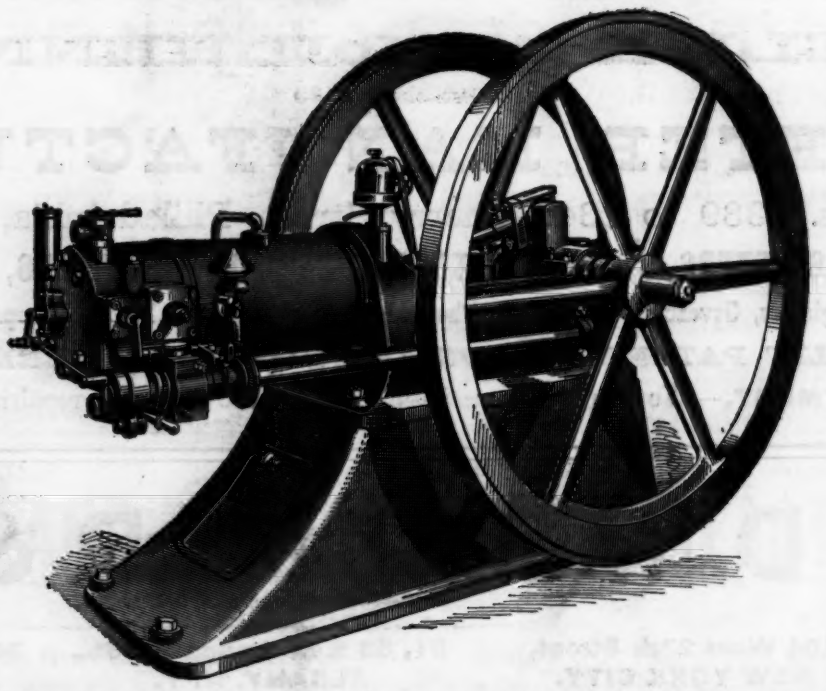

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